DK

JEWEL

A CELEBRATION OF EARTH'S TREASURES

FOREWORD BY JUDITH MILLER

JEWEL

JEWEL

A CELEBRATION OF EARTH'S TREASURES

DK

DK | Penguin Random House

DK LONDON

Senior Editor	Anna Fischel
Senior Art Editors	Jane Ewart, Gadi Farfour
Project Editor	Hugo Wilkinson
Designers	Helen Spencer, Stephen Bere, Katie Cavanagh, Renata Latipova, Clare Joyce
Photographer	Ruth Jenkinson
Picture Research	Sarah Smithies
DK Picture Library	Martin Copeland
Jacket Designer	Mark Cavanagh
Jacket Editor	Claire Gell
Jacket Design Development	Sophia MTT
Producer	Mandy Innes
Pre-Production Producer	Andy Hilliard
Managing Editor	Gareth Jones
Managing Art Editor	Lee Griffiths
Art Director	Karen Self
Associate Publishing Director	Liz Wheeler
Publishing Director	Jonathan Metcalf

DK INDIA

Senior Managing Art Editor	Arunesh Talapatra
Senior Art Editor	Chhaya Sajwan
Art Editors	Priyansha Tuli, Roshni Kapur, Sudakshina Basu
Production Manager	Pankaj Sharma
Pre-production Manager	Balwant Singh
Senior DTP Designer	Neeraj Bhatia
DTP Designers	Jaypal Chauhan, Nityanand Kumar
Picture Research Manager	Taiyaba Khatoon
Picture Researcher	Sakshi Saluja

First published in Great Britain in 2016
by Dorling Kindersley Limited
80 Strand, London WC2R 0RL

16 17 18 19 20 10 9 8 7 6 5 4 3 2 1
001–282973–Oct/2016

A CIP catalogue record for this book is available from the British Library.

ISBN 978-0-2412-2603-2

Printed and bound in China

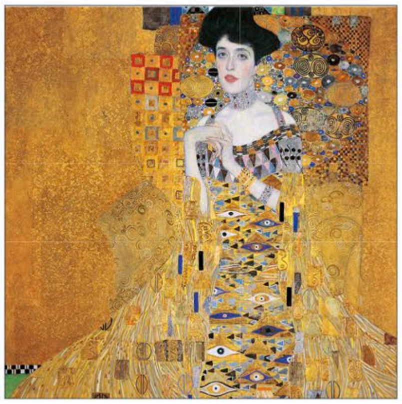
A WORLD OF IDEAS:
SEE ALL THERE IS TO KNOW

www.dk.com

Contents

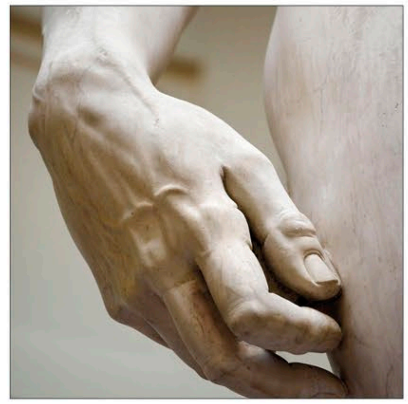



GEMSTONES 64





MARI
MOST
HENRI
AGE OF
XXVIII



Foreword

by Judith Miller

The lure of precious stones and gems is universal – it is common to every age and every culture. From the moment a sparkling mineral first caught the eye of a caveman, humans have been fascinated by the wonders of the earth beneath their feet, and have marvelled at the different ways that stones and crystals react with the light, at their varied properties and uses, and at the way that they appear miraculously transformed when cut and polished.

This appeal goes far beyond visual beauty – throughout history, mysterious powers have been ascribed to certain gems and minerals. Healers deemed some gems to have medicinal qualities, while astrologers and alchemists utilized others; the sacred texts of major religions mentioned precious stones, and jewels frequently featured in ritual practices. Some Chinese emperors, for example, were buried in jade suits, in the belief that this stone conferred a form of immortality; similarly, the precious gems and metals used in the complex burial rites of Egyptian pharaohs were designed to ease their passage into the afterlife.

Many jewels have become woven into the fabric of national mythologies. In Australia, opals feature prominently in enchanting creation stories, which are set in the Dreamtime of the Aboriginal peoples. In Britain, meanwhile, there is a colourful legend surrounding one of the oldest stones in the Crown Jewels, St Edward's sapphire – according to tradition, this jewel came from a ring worn by Edward the Confessor, who generously gave it to a beggar. Many years later, the stranger returned it to him, joyously revealing that he was no beggar, but John the Evangelist and that Edward would soon be joining him in Paradise.

Sometimes, an entire industry could arise from a gemstone's associations, typified by the links between jet and mourning. This sleek, black substance was scattered on funeral pyres in Bronze-Age burials and the Romans were also fond of using it. The gem went out fashion for a time, but enjoyed a resurgence in popularity in the 19th century: Queen Victoria wore jet adornments throughout her long years of mourning for Prince Albert, and her example was followed by other widows in Britain. For

“Now, more than ever, jewels can have a unique, personal significance for us all”

a time, the economy of Whitby in North Yorkshire – the principal, local source of jet – revolved around the production of items for this sombre trade.

The work of skilled lapidaries and carvers can also be seen in buildings, such as the mysterious Russian Amber Room – treasure-hunters have searched in vain for this enigmatic piece, so far without success. Elsewhere, the Alhambra in Spain and the Taj Mahal in India both feature stunning carvings in precious and semi-precious materials.

The most common use of jewels, of course, is to be worn. Throughout history, the most powerful figures have competed to own spectacular jewels. In ancient times, it was a matter of pride to be buried along with one’s most prestigious possessions, and archaeologists have learned a great deal from the jewellery discovered in high-status graves. Later rulers amassed large collections, sometimes establishing their own mines or creating a monopoly to ensure that they acquired the best examples. In particular, they sought jewels that were exceptional for their size, rarity, or beauty. In the modern era, lovers of gemstones have placed a greater emphasis on fashion and design. The figures of high society – film stars, royalty, and other celebrities – all want to be photographed wearing an exquisite piece by one of the great names in modern jewellery design – Fabergé, Cartier, Lalique, Tiffany.

Above all, jewels are symbols of romance: throughout the ages, they have been exchanged as love tokens. The finest examples have a history all of their own, passing from one distinguished owner to the next. A huge pearl, *La Peregrina* (“the Pilgrim”), was given to Queen Mary of England in the 1550s, as an engagement present. It was later owned by Margaret of Austria and Joseph Bonaparte of Spain, before eventually Richard Burton purchased it for Elizabeth Taylor.

Fortunately, not every love token costs a king’s ransom. Wedding rings have been presented since ancient Egyptian times but, from the early 20th century, it has become fashionable to give jewellery with birthstones or anniversary stones on special occasions. Now, more than ever, jewels can have a unique, personal significance for us all.

0

Introduction

Treasures of the Earth

The precious metals and gemstones that have been used for decoration and trade throughout human history have their origin in the rocks that surround us. Many of these began as mineral crystals that formed as a result of geological changes over millennia. The crystals are extracted, then cut, faceted, and polished to be used in jewellery and other decorative items. Organic gems are made of biologically derived matter, such as pearls produced by oysters, and amber, a form of fossilized tree resin. The financial worth and perceived value of these precious materials can vary from society to society – in some cultures, jade is more valuable than gold, for example. Rubies are among the most highly valued gemstones in the West – the 25.6-carat "Sunrise Ruby", mounted as a ring by Cartier, was sold for around $30 million in 2015.

Three rock types

Components of the Earth

There are three major classes of rock: igneous, sedimentary, and metamorphic. Igneous rocks are either formed from magma (molten rock) that has solidified underground, creating intrusive rocks such as granite, or has flowed onto the land or sea bed, forming extrusive rocks such as basalt. Most sedimentary rocks, such as sandstone, are made of deposits laid down on the Earth's surface by wind, water, or ice. Metamorphic rocks are formed when the mineralogical composition of existing rocks is altered. Quartzite, for example, is metamorphosed sandstone.

Igneous rock This example of intrusive igneous rock, granite, is formed inside the Earth when magma cools. Tiny crystals can be seen on its surface.

Sedimentary rock Sandstone usually contains quartz but other minerals can also be present. This example shows patches of iron oxide and flakes of mica.

Metamorphic rock The component minerals of gneiss – mainly quartz and feldspar – tend to separate out into distinct bands of different colours.

Bevelled, tabular crystal, typical of the mineral wulfenite

Minerals

Most gems are cut crystals of minerals. A mineral is defined as a naturally occurring solid with a specific chemical composition and a distinctive crystal structure (see pp.14–15). Each mineral has a unique name based on these two criteria. If either of these changes, it becomes a different mineral with a different name.

Rocks

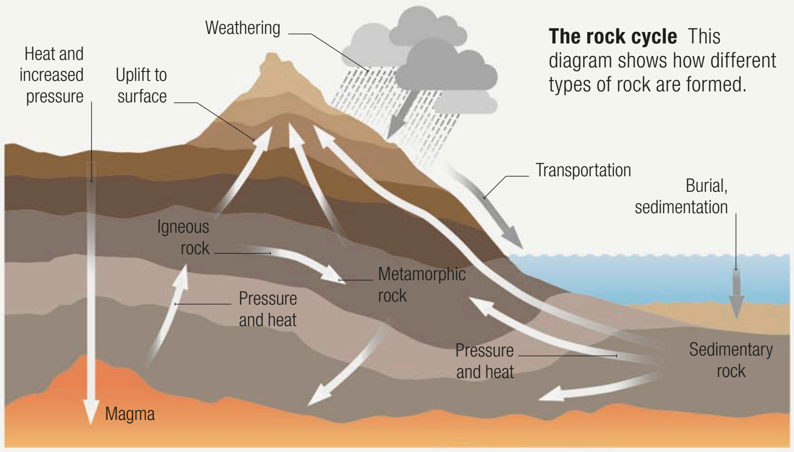
The Earth's rocks (see box, left) are made up of naturally occurring aggregates of one or more minerals, although there are a few rocks made from organic substances, such as decayed vegetation, which is the source of coal.

Specimen of rough marble

Gems in the Earth

The origins of rocks, minerals, and gemstones

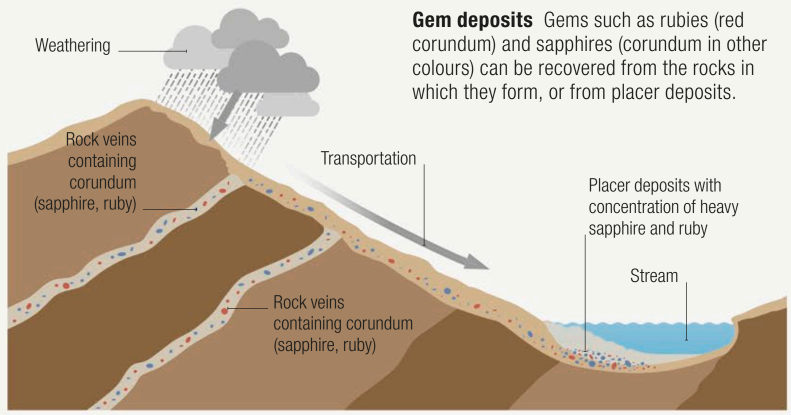
Rocks and minerals are created in the rock cycle. All rocks begin as igneous, but over time they are altered by re-melting, erosion, or metamorphosis – weathering and erosion lead to the formation of sedimentary rock, which can turn into metamorphic rock through temperature or pressure conditions.



The rock cycle This diagram shows how different types of rock are formed.

GEMS IN NATURE

Mineral gemstones are directly mined from the rocks in which they were originally formed (see p.25): examples of these include diamond, tanzanite, ruby, kyanite, celestine, emerald, tourmaline, and aquamarine. Other types of gem, released from their original rock by weathering, can be mined from placer deposits found in stream gravels. Examples of these varieties include topaz, sapphire, chrysoberyl, garnet, zircon, and spinel.



Gem deposits Gems such as rubies (red corundum) and sapphires (corundum in other colours) can be recovered from the rocks in which they form, or from placer deposits.

Crystals

A crystal is a solid, the component atoms of which are arranged in a particular, repeating, three-dimensional pattern. When these internal patterns produce a series of external, flat faces arranged geometrically, a crystal, such as the rhodochrosite above, is created.

Polished copper and silver in a rock matrix

Native elements

These are chemical elements that occur in nature uncombined with other elements (see also p.14), including gold, silver, and diamond (carbon). With the exception of platinum and gold, most metals are extracted from minerals that contain them.

Stalactitic amber

Organic gems

Created through organic processes, organic gems are not commonly crystalline. Jet is a form of coal, derived from plant matter; coral and shell are the secreted skeletons of marine animals, while pearls are formed by shelled molluscs; and amber and copal are tree resins, fossilized and semi-fossilized. Organic gems are generally softer than minerals and easier to work.

What is a mineral?

Minerals are the substances that make up the Earth's rocks. Each one has its own unique chemical composition and internal atomic structure – indeed, a mineral is defined by its chemical elements and by the atomic structure of its crystallization. Minerals are usually formed by inorganic processes, although there are organically produced substances such as the hydroxylapatite in teeth and bones that are also considered minerals. Certain substances, including opal and glass, resemble minerals in appearance, chemistry, and occurrence, but do not have a regularly ordered internal arrangement and so do not exhibit crystallinity: these are known as mineraloids.

A few minerals occur as a single chemical element: these are known as "native elements" and include gold, silver, and diamond (see below). However, most minerals are chemical compounds, composed of two or more chemical elements. There are around 100 types of mineral that are considered common, out of more than 5,100 known minerals.

Mineral classification

Minerals are grouped according to their chemical composition. A mineral compound has positively and negatively charged atoms or groups of atoms: the atoms that carry the negative electrical charge determine which chemical group a mineral is assigned to. The largest mineral group, the silicates, is further divided into six sub-groups based on their different chemical structures.

Gold nugget

Fluorite crystals

Rough chrysocolla with azurite

Celestine cystals

Native elements

Minerals made up of atoms from a single element are known as native elements. The most common are metals such as copper, iron, silver, gold, and platinum, and non-metals such as sulphur and carbon (as graphite and diamond). A few others occur in minute amounts, often alloyed with other native elements.

Halides

Halides consist of various metals combined with one of the common halogen elements: fluorine, chlorine, bromine, or iodine. There are three categories of halide: simple halides; halide complexes; and oxyhydroxy-halides. All halides are soft, and thus there are few gemstone varieties, except for fluorite.

Carbonates

A mineral in the carbonate group is characterized as having a carbon atom at the centre of a triangle of oxygen atoms, which gives rise to trigonal symmetry (see pp.18–19). Examples of carbonates as gemstones include chrysocolla, calcite, smithsonite, and malachite.

Sulphates

Sulphate minerals have a crystal structure consisting of four oxygen atoms, with a sulphur atom in the centre; this combines with one or more metals or semi-metals. Some examples of sulphates include baryte, celestine, and alabaster (a variety of the sulphate mineral gypsum).

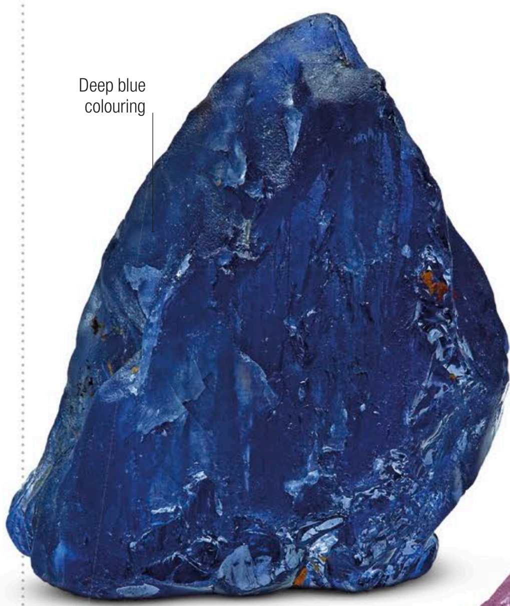
Sulphides

Sulphide minerals are those in which sulphur is combined with one or more metals. Many of the sulphides are brilliantly coloured, and most have low hardness and high specific gravity. Examples of sulphides include pyrite, marcasite, and sphalerite.

Sphalerite rough

Oxides

Minerals of the oxide group consist of oxygen atoms combined with a metal or semi-metal. An example of this is aluminium oxide, or corundum – ruby and sapphire. Other gemstone varieties include spinel – often mistaken for ruby – hematite, and rutile.

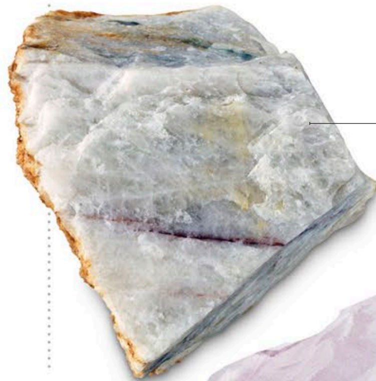


Deep blue colouring

Sapphire rough

Phosphates

These minerals are grouped according to the similarity of their crystal structures – phosphate minerals contain phosphorus and oxygen combined in a 1:4 ratio. Some examples of phosphates that occur as gemstones include amblygonite, apatite, and turquoise.



Vitreous to pearly lustre

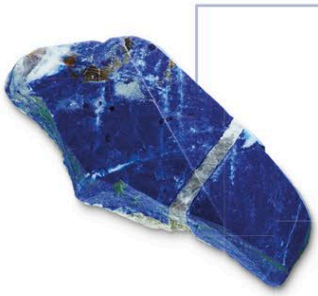
Amblygonite rough

Violet colour caused by iron and natural radiation

Amethyst rough

Silicates

All silicates consist of silicon and oxygen atoms, structured as a central silicon atom with oxygen atoms around it in various configurations. Silicates are divided into subgroups according to the varying structural configurations of their atoms; of these, inosilicates are sub-divided into two further groups, as below. Silicates include many gemstones such as quartz and tourmaline.



Tectosilicates
Tectosilicates include lazurite (above), opal, quartz varieties such as amethyst, and more.

Phyllosilicates
This group includes chrysocolla, soapstone, and clay minerals, among others.

Single-chain inosilicates
Single chain inosilicates include kunzite (above), enstatite, diposide, and others.

Double-chain inosilicates
Double-chain inosilicates include nephrite (above), edenite, and others.

Cyclosilicates
Emerald (above) is the best-known member of this group, which features tourmaline.

Sorosilicates
Sorosilicates include vesuvianite, zoisite, and other minerals.

Physical properties

When the need arises to identify or value a gem, it is sent to a professional gemologist who is certified by a professional gemological body. The gemologist will examine the gemstone for various physical and optical properties in order to make an identification and evaluate its quality.

An essential quality of a gemstone is durability. A gemstone's physical properties determine how durable it is, and how susceptible it is to wear, breakage, and deterioration, as well as the quality of its colour. Note that gems with good cleavage (see right) can be very hard but still be susceptible to cracking.

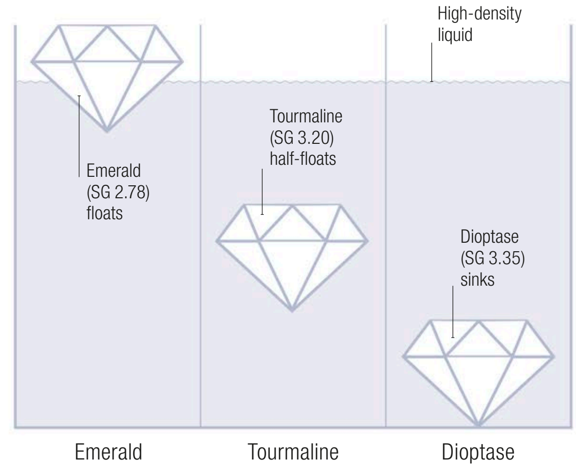
Hardness

One of the principal determinants of durability is the gem's hardness, or the relative ease or difficulty with which it can be scratched. Measured on the Mohs scale, hardness does not equate to strength, as very hard minerals can also be quite brittle. Gemstones below 5 on the scale are too soft for wear and even stones of 6 or 7 will scratch and abrade.

Aquamarine

Specific gravity

Specific gravity (SG) is a measure of the density of a substance relative to that of water, and determines how dense a gemstone is. It is measured as the ratio of the mass of the substance and the mass of an equal volume of water – so a mineral with an SG of 2 is twice as heavy as water. Specific gravity can be determined using specialized balances or liquids that allow minerals below a given SG to float and those above it to sink. However, experts can often gauge the specific gravity of a gem purely by its heft.



Cleavage

Cleavage is the property of a mineral that causes it to break along its atomic layers, where the forces bonding its atoms are the weakest. Some gems have cleavages in several directions, some of which may be very easy to trigger, meaning that the gem can be easily broken if sharply knocked. Because they follow the atomic planes, cleavage surfaces are often smooth.

Perfect cleavage is the breakage of a mineral along an atomic plane, where the bonds are weakest, and where the breakage leaves a flat surface.

Streak

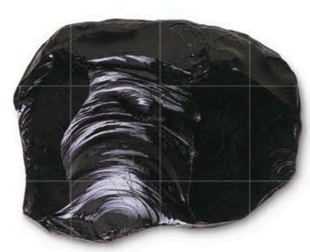
Streak is the colour of the powdered mineral, determined by rubbing a piece of the mineral across a piece of unglazed porcelain, leaving a streak of colour. This can be used for identification, particularly with minerals that occur in different colours.

Streak can be more consistent in minerals than colour – in fact, a mineral that occurs in different colour varieties may have the same colour streak. In this example, three colour varieties of the mineral fluorite rough are shown. In a streak test, the purple, orange, and green fluorite specimens would all give a white streak.

Diamond

Fracture

Fracture is another way of describing how a mineral breaks. In fracture, however, breakage takes place across the mineral's atomic planes, rather than along them, as it does in cleavage, because there are no obvious planes of fracture. Distinctive fracture may help with identification.



Obsidian

Conchoidal fracture is where the breakage has a shell-like appearance. Quartz and glass gemstones – such as obsidian – show conchoidal fracture.

Chalcopyrite

Even fracture has a broken surface that is roughly textured, but flat. **Uneven fracture**, as in the chalcopyrite above, has a rough and irregular surface.

Gold

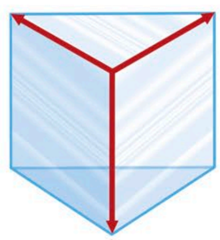
Hackly fracture shows an uneven surface with sharp edges and jagged points. It is characteristic of broken or torn metals and a few other minerals.

Crystal systems and habits

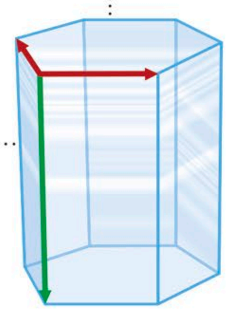
A crystal is a solid in which the component atoms are arranged in a particular, repeating, three-dimensional pattern. When these internal patterns produce a series of external, flat faces arranged in geometric forms, this forms a crystal. These repeating structures are identical structural units of atoms or molecules, and are called unit cells. The unit cell is reproduced over and over in three dimensions, meaning that the shape of the crystal will resemble that of the individual unit cell. The crystals of different minerals can have unit cells that are the same shape but are made of different chemical elements. Because a crystal is built up of repeating geometric patterns, all crystals exhibit symmetry, depending on the basic geometry of their unit cells. These fall into seven main groups and are called crystal systems. The final external form a crystal takes is known as its habit, and the shape produced by a mass of numerous identical crystals is a growth habit (see opposite).

Minerals and crystal systems

Mineralogists and crystallographers have a complex set of criteria for determining which mineral belongs in which crystal system, based on symmetry. In practical terms, these systems can be understood as a group of three-dimensional cells starting with the basic cube (below). It should be noted that hexagonal and trigonal systems (right) are considered to be one system by some crystallographers.

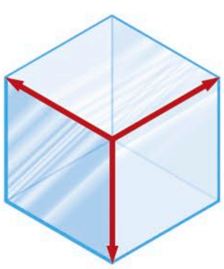


Trigonal a=b=c The first hexagonal cell is further altered by squeezing two opposing short edges, so that all of the faces are lozenge-shaped. The angle between a and b is 120 degrees. In the USA, the trigonal is considered a division of the hexagonal.

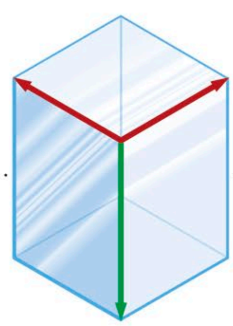


Hexagonal a=b≠c To create the hexagonal system, two of the opposing long edges of tetragonal cell are squeezed together, leaving rectangular sides but lozenge-shaped ends.

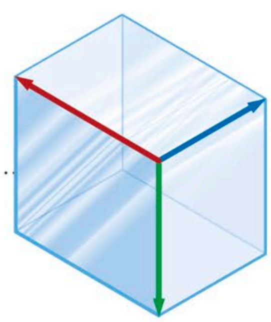
When two or more crystals of the same variety are intergrown symmetrically, they are referred to as twinned



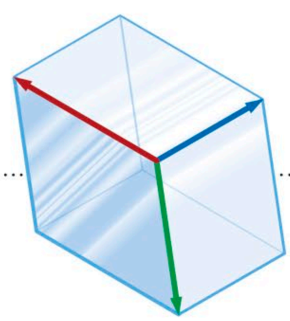
Cubic a=b=c The cubic unit cell has three right angles, and the lengths of its sides are all equal. Thus, relative to the length of its sides, a equals b equals c.



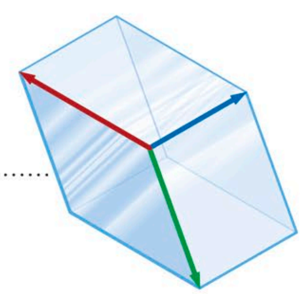
Tetragonal a=b≠c If the cubic cell is stretched vertically, there are still three right angles, but the length of the vertical side is longer than the other two. Now, a equals b does not equal c.



Orthorhombic a≠b≠c If the tetragonal cell is stretched horizontally, the three right angles remain, but now none of the sides are of equal length. Thus, a does not equal b does not equal c.



Monoclinic a≠b≠c The monoclinic system is created if the orthorhombic cell is skewed in one direction, only two right angles remain, and a does not equal b does not equal c.

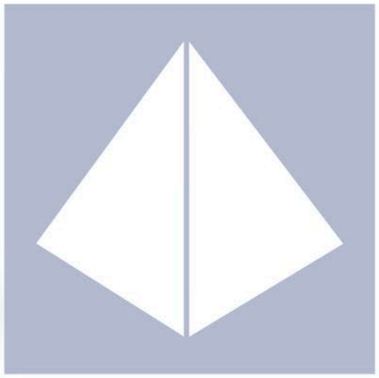


Triclinic a≠b≠c To create the triclinic system, all of the faces are skewed so that no right angles remain, and none of the edges of the faces are equal.

GREATEST SYMMETRY — LEAST SYMMETRY

Pyramidal

Pyramidal crystal forms are, literally, in the shape of pyramids – pyramidal faces predominate in the crystal's shape. If pyramid faces occur in two directions with the pyramids base-to-base, the habit is dipyramidal.

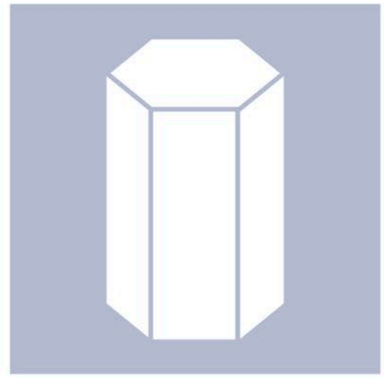


Pyramidal crystal form

Dipyramidal sapphire crystal

Prismatic

Prismatic crystals form long, pencil-like shapes in which the length will be several times the diameter. Some prismatic crystals will have very regular, flat, rectangular faces, like aquamarine. In other minerals like tourmaline, the rectangular faces may be curved, to form a cross section like a triangle with curved edges.



Prismatic crystal form

Prism-shaped aquamarine crystal

Acicular

Crystals are said to be acicular when they are thin and needle-like. In general there are few gemstones cut from acicular crystals, but when the needles are parallel and compact, they assume a fibrous form. Satin spar and tiger eye occur in such forms.

Acicular crystal form

Needle-like thomsonite crystals

Dendritic

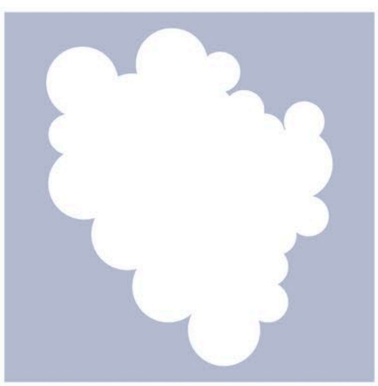
In the dendritic crystal habit, aggregates of small crystals form in slender, divergent, somewhat plantlike branches. These are particularly common in copper, silver, and gold. Dendrites of iron and manganese oxide sometimes penetrate chalcedony to form dendritic agate.

Dendritic crystal form

Branch-like silver

Botryoidal

Botryoidal minerals form in globular aggregates, which often resemble bunches of grapes in shape. Hematite, chalcedony, and malachite are minerals that are found in botryoidal form. Malachite, in particular, is often cut and polished across the rounded masses, to reveal bull's-eye patterns.

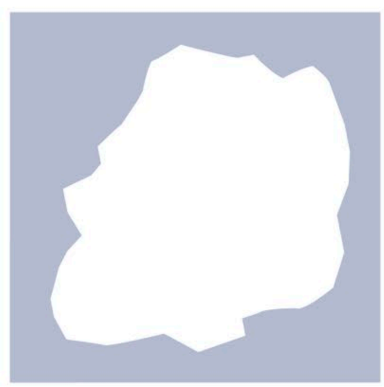


Botryoidal crystal form

Bubble-like hemimorphite crystals

Massive

A mineral is said to be massive when it is a mass of tiny crystals that cannot be seen individually. Many gem minerals have their massive counterparts; other gem materials only occur in massive form. Massive minerals tend to be opaque, or at best translucent, and are cut as cabochons or used for carvings.



Massive crystal form

Massive sugilite (purple) on rock groundmass

What is a gem?

A gem is generally defined as any mineral that is highly prized for its beauty, durability, and rarity, is used for personal adornment, and has been enhanced in some manner by altering its shape – usually by cutting and polishing. A wider definition includes a few rocks, such as obsidian, and a few organic substances, such as amber (a fossilized resin). By far the majority of gems, however, are cut from the crystals of minerals. Precious metals are not considered to be gems, nor are items carved from minerals but not used for personal adornment, such as figurines, bowls, or vases.

Beauty

The first quality a gem must possess is that of beauty. This is subjective: some may prize a gem's interplay of light and colour, while others may first be drawn to a gem's intricate cut. With an almost endless combination of colour, shape, and fire (play of light), gemstones are capable of a range of aesthetic styles.

Blue sapphire, prized for its beauty

Durability

Hardness or toughness in a gem is a desirable quality, suggesting enduring value. Some gems require care to prolong their longevity. Certain gems resist chipping or scratching, but fade after long exposure to direct light; dry environments may cause some to crack, while others are susceptible to damage from acids.

Diamond, the hardest gemstone

Rarity

A gem may be rare for a number of reasons. The gem material itself may be rare, such as emerald, or a more common material may exhibit an unusual colour or clarity. Some particularly soft or fragile stones are rare in cut form, as they require the work of highly skilled lapidaries.

Taaffeite, noted for its rarity

Other considerations

The desirability of a gem can depend on factors besides beauty, rarity, and durability. Gems may be symbolic of power, such as those mounted in crowns, or valued for their history or circumstances of origin. They may also be prized for their connection to astrology or mysticism, for their geological associations, or as fashion items.

Tanzanite, both rare and difficult to cut

Synthetic gems

Synthetic gems are identical to natural minerals physically, chemically, and optically, but are made in a laboratory. The two main ways to create them are from melt or solution. In production from melt, a powdered material, chemically equivalent to a natural mineral, is melted at high heat, then manipulated to solidify in a crystalline form. Production from solution involves dissolving one set of materials in a solution of different materials, again using high heat, then manipulating the solution so it precipitates into crystalline form. In both methods, crystals form on a seed crystal as the temperature is lowered.

Natural gemstones for comparison

Synthetic examples of gemstones

Opal

Synthetic opal

Diamond

Synthetic diamond

Emerald

Synthetic emerald

How qualities add up

Value, quality, and different varieties

Gems are defined by the very qualities that give them their value (see pp.30–31) – a gem would not be a gem without some level of material purity and craftsmanship. However, not all gems are equal.

COMPARATIVE GEM VALUES

The chart below compares a selection of popular gemstones according to their approximate monetary value (see p.27 for information on valuing diamonds, not included here). Varieties such as alexandrite, sapphire, and ruby are scarce and sought-after, and thus expensive; others, such as ruby, can vary hugely in cost, from modest to priceless. In general, the greater the clarity, size, and beauty of colour, the more you will pay.

Optical variations Each gem has a wide-ranging set of optical properties, both in terms of colour and of clarity. During identification the gemologist has to take these into account, as well as the gem's refractive index (RI), its specific gravity (SG), hardness, lustre, and dichroism.

Visual properties

How a gem interacts with light is the very essence of its nature. Light is the source of a gemstone's beauty, colour, and sparkle; it is also a useful tool for the identification of gems, as each stone has its own particular set of optical properties. For example, there are a dozen or more red gemstones, and many of the red hues within each type of stone will have many different shades. All these properties are a way of identifying gemstones, although no single one is diagnostic in itself. Some categories such as lustre are subjective observations; others, such as a mineral's refractive index, are objective. A gemologist identifying a stone will use a number of different methods and instruments to narrow the possibilities. Examination of one or all of the optical properties of the stone will show how it transmits, bends, and reflects light – just one of these may suffice for identification; in other instances, a complex combination of physical and optical properties may be needed.

Colour

One of the most desirable qualities in a gemstone is beauty, and an important part of this is the stone's colour. In gems, colour is caused when light is absorbed within the crystal, or refracted – changing direction as it passes through the gem. White light is composed of many colours; when one or more of those colours is absorbed, the remaining light emerging from the gem is coloured. This can be brought about by the presence of trace elements that cause certain wavelengths to be absorbed, or can be a part of the gem's chemical structure (see below).

Idiochromatic gems Idiochromatic gems are those sometimes described as "self-coloured", as their colour is inherent in their chemical make-up. Rhodochrosite is a manganese carbonate with a naturally pink to red colour due to its manganese content, and peridot is an iron magnesium silicate, which is green as a result of its iron content.

Peridot

Ruby

Allochromatic gems Allochromatic gems are those coloured by trace elements in their structure. Amethyst and ruby are examples of these: amethyst is colourless quartz made purple by traces of iron, while ruby is corundum coloured by traces of chromium.

Parti-colouring Gems with different colours within the same stone are called parti-coloured. Gems with two colours are called bicoloured; those with three colours, tricoloured. Rarely, a dozen or more colours can occur. Divisions between the colours can be abrupt or gradual. Parti-colouring is often caused by changes in the chemical medium in which the crystal has grown.

Watermelon tourmaline

Iolite seen from the top

Iolite seen from the side

Pleochroic gems As white light passes through a gemstone, colours are absorbed differently in different directions: as a consequence, a stone can be a different colour when viewed from different angles. This effect is called pleochroism, and it can be an important aid to the identification of cut stones.

Lustre

A gem's lustre is the general appearance of its surface in reflected light. There are two basic types of lustre: metallic and non-metallic. Precious metals have metallic lustres, and gemstones non-metallic, with the exception of a few like hematite and pyrite. Lustres that relate to gems include vitreous, waxy, pearly, silky, resinous, greasy, earthy, metallic, and adamantine.

Diamond

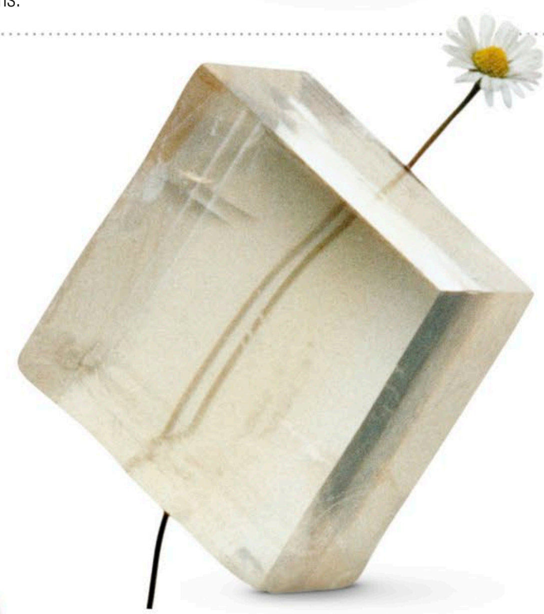
Adamantine lustre Gems that demonstrate an extraordinary brilliance and shine have an adamantine lustre. It is a relatively uncommon lustre, possessed by diamonds, some zircons, and a very few other gems.

Refractive index

When light passes through a transparent gem, it changes speed and direction. This is called refraction. The change in the speed of light as it passes from the air into a gem is called the refractive index (RI). The change in direction, or bending, of the light can be used to calculate the gem's RI. Diamond's high RI results in flashes of light seen when the gem is moved – its "fire". The greater the dispersion of the white light, the greater the fire.

High refractive index (RI)

Low refractive index (RI)

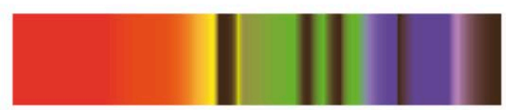


Double refraction Gemstone minerals in the cubic system bend light equally in all directions. Other types of crystal system bend light in two directions, with the crystal structure causing light to bend at two different angles. This is called double refraction.

Spectroscopy

The study of the emission of light according to its wavelength is called spectroscopy. Devices known as spectroscopes are used to measure light waves as they pass through gemstones. The spectroscope has a small slit for light to pass through. When a gem is placed between a light source and the slit, a light spectrum is produced. Dark bands appear where certain wavelengths are absorbed by the stone. These bands are characteristic of various elements, enabling identification of the gem's chemical make-up. The three spectra on the right reveal much about the gems' composition.

Ruby



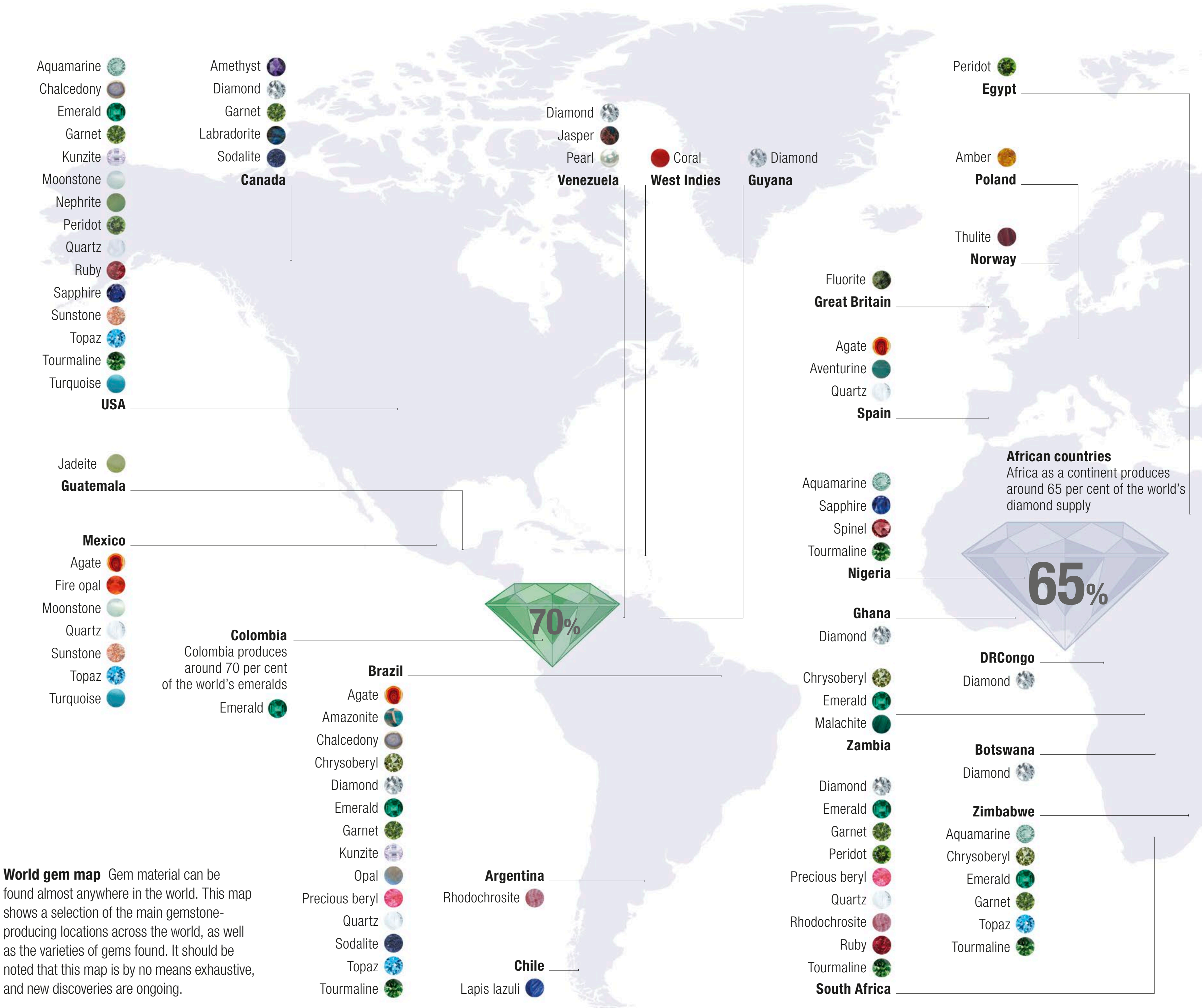
Almandine garnet

Red glass

Spectra Ruby's simple composition shows only a few dark bands or lines. Almandine, meanwhile, shows numerous lines, due to its complex composition, while glass is made of only two elements, so displays only two absorption areas.

Where do gems come from?

Gems are found worldwide, but some areas are exceptionally rich sources: Myanmar contributes a huge amount of the world's ruby supply; Australia formerly dominated the precious opal market, although Ethiopia is now producing large quantities. The highest volume of fine emeralds comes from Colombia, while Madagascar is richest in sapphires. Diamond supply has been led by Botswana in recent years, although many stones are now coming out of Russia and Canada.



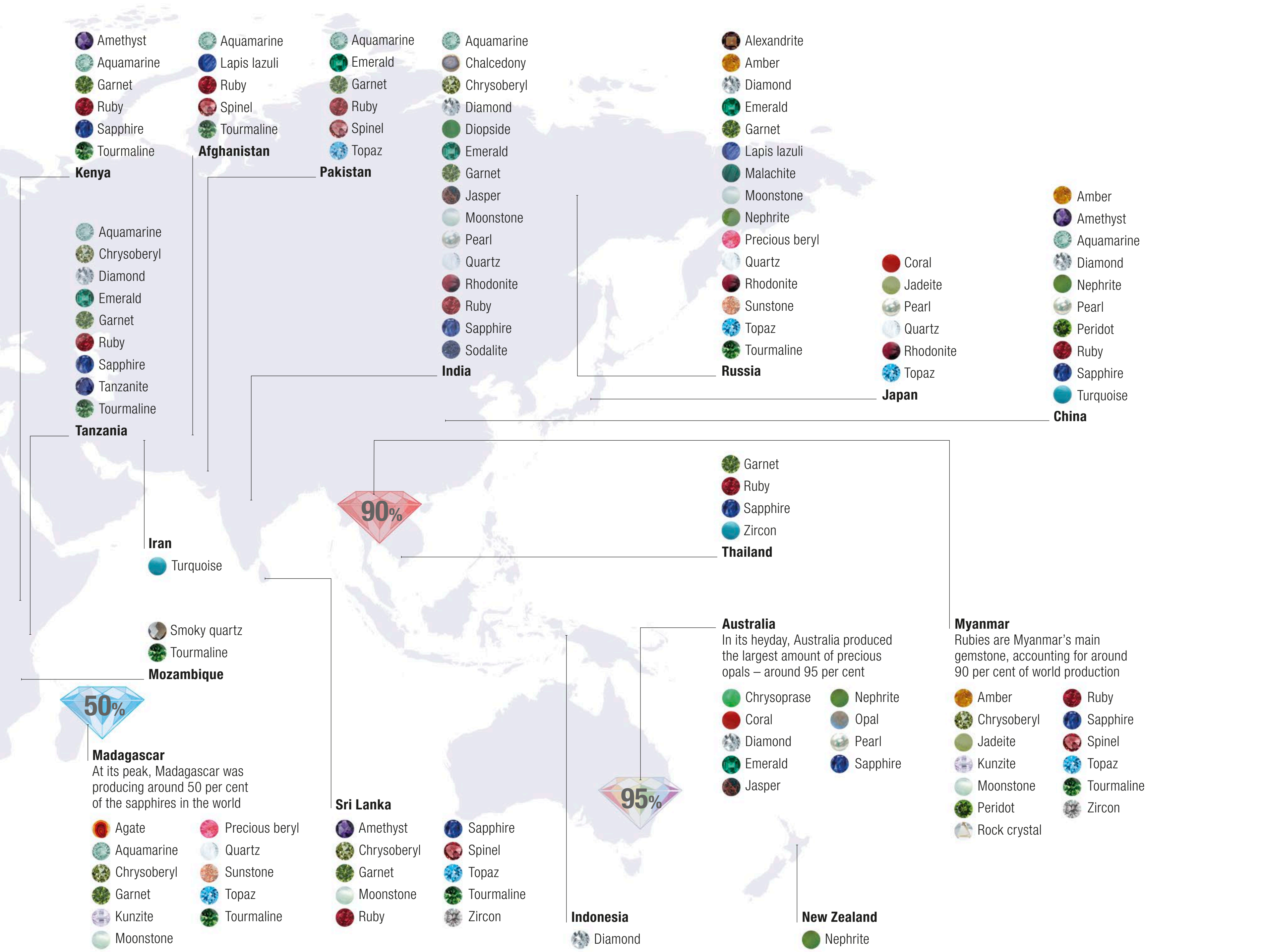
World gem map Gem material can be found almost anywhere in the world. This map shows a selection of the main gemstone-producing locations across the world, as well as the varieties of gems found. It should be noted that this map is by no means exhaustive, and new discoveries are ongoing.

Mining for gems

Revealing the treasures of the Earth

Large-scale mining for precious materials is mainly reserved for "big names", such as gold, silver, and diamonds, as well as less precious material used in industry, such as copper. Some large-scale mines also produce fine gem material, such as malachite and turquoise, as by-products. Much gem mining is relatively small scale, however, and is often done using only hand tools.

The Superpit Located in Kalgoorlie in central Western Australia, the Superpit is Australia's largest open pit gold mine and is one of the largest open pit mines in the world.



Grading and evaluation

The grading and evaluation of gems can start even before they are removed from the ground. Within some gem deposits, certain areas are known to yield more or better-quality gem material, and are thus mined first. Only a small percentage of what is recovered is actually of gem quality, and this is further sorted to separate out the gem material. Any gem-quality roughs found are then carefully evaluated for colour, clarity, and size. Even much of this selected material may remain uncut if it is too small, oddly shaped, or for some reason does not fit the current market demand. Cutting is expensive and time-consuming, and so meticulous grading at this early stage is essential. To be certain, the cutter will make his or her final decision about what is cut, but the greater the evaluation and grading before gems reach the cutter's workshop, the better.

Non-gem quality

The specimen shown here is of ordinary zoisite, and is typical of virtually all zoisite material. It is opaque, and even when well crystallized, it is not of gem quality. Until the discovery of tanzanite, zoisite's gem-quality variant (see p.253), only a tiny amount of gem-quality zoisite was known.

Zoisite crystal This zoisite rough is not of gem quality and would be of value purely as a mineral sample.

> **The jewel... is concentrated brilliancy, the quintessence of light**
>
> Charles **Blanc**
> 19th-century author

Mid-gem quality

Because tanzanite is a relatively uncommon stone, even medium-quality gems are valuable enough to facet. In more common stones, such as amethyst, a mid-quality rough is seldom faceted because the cost of cutting it would exceed the final value of the finished gem.

Pale tanzanite rough This rough crystal is gem quality, but has a number of small flaws and inclusions.

Cut pale tanzanite Faceting can be used to conceal or disguise internal imperfections in mid-quality gems, as seen in this example.

Superior quality

A relatively small portion of even a select gemstone rough is of superior quality. In this tanzanite example, both the rough and the cut stone are of visibly higher quality than the mid-quality grade (above).

Superior-quality tanzanite rough Even as a rough, the quality of this tanzanite can be seen in its deep colour and clear interior.

Cut tanzanite The best-quality gemstones combine superior-grade material with highly skilled craftsmanship, as in this stone.

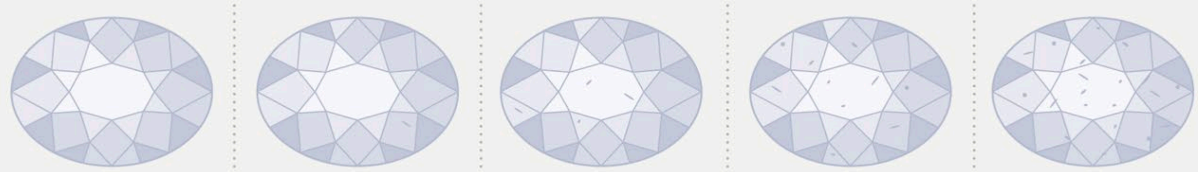
Grading and valuing diamonds

The most precious gem of all

In general, intensely coloured natural diamonds command very high prices. However, "colourless" diamonds, because they have a generally higher value than most "coloured" stones, are graded by a more complex system. A single change in grade can result in a large difference in value. To avoid the large value changes between the grades that would occur if there were only a few grades, there are numerous grades based on each of the four "Cs" (see p.30), thus keeping the changes in value relatively small. The grades and their determinates below are those of the Gemological Institute of America (GIA).

Clarity grading scale The clarity scale runs in stages from visually flawless to stones with numerous visible inclusions.

IF (Internally flawless)	VVS1, VVS2 (Very, very slightly included 1 and 2)	VS1, VS2 (Very slightly included 1 and 2)	SI1, SI2 (Slightly included 1 and 2)	I1, I2, I3 (Included 1, 2, and 3)



Colour grading scale The most common colour tint for "white" diamonds is yellow. This scale grades colour according to the amount of yellow present, beginning at "D" for colourless, all the way to "Z" for light yellow (also brown or grey).

D E F	G H I J	K L M	N O P Q R	S T U V W X Y Z
Colourless	Near colourless	Faint yellow	Very light yellow	Light yellow

Type I gems

Gemstones of Type I level are usually "eye-clean" as standard, with no visible inclusions. Stones in this category are usually of such high clarity that they will be free of even minor inclusions. For lapidaries, collectors, and jewellers, these stones represent the height of desirability.


Aquamarine


Chrysoberyl, yellow


Chrysoberyl, green


Helidore


Hiddenite


Kunzite


Morganite


Quartz, smoky


Tanzanite


Tourmaline, green


Zircon, blue


Diamond

Type II gems

Gems of the Type II category typically display some inclusions that are visible to the naked eye but do not detract from the desirability and overall beauty of the gemstone. Many such stones with visible inclusions are faceted for use in jewellery.


Andalusite


Alexandrite


Garnet


Iolite


Peridot


Quartz, amethyst


Quartz, citrine


Quartz, ametrine


Ruby


Sapphire


Tourmaline: all except red, green, and watermelon


Zircon: all except blue

Type III gems

The Type III classification is mainly applied to gemstones that feature obvious inclusions or other imperfections. However, even stones with prominent inclusions are regularly cut for use in jewellery, and are considered beautiful objects in ther own right.


Emerald


Red beryl


Tourmaline, watermelon (above), and red only

Only around 30 per cent of diamonds mined worldwide are classified as being of gem quality

Gem cuts

Stones are reshaped to enhance their beauty and to increase their value. A finished gem can be many times the value of its rough, and it is also far more sellable. Gemstone rough may be sawn to remove poor areas, to separate valuable areas from within a larger stone, or to create a preliminary shape. Arriving at the final shape and form of a gem (its "cut") then involves various stages of grinding and polishing. The cut used on a particular piece of gem rough is determined by a number of factors in combination: the shape of the rough, the position of its flaws, its cleavage, the best orientation to display its colour (in the case of star-stones, for example, the cut is oriented so that the star is centred in the finished stone), and the most suitable cabochon shape if the stone is translucent or opaque.

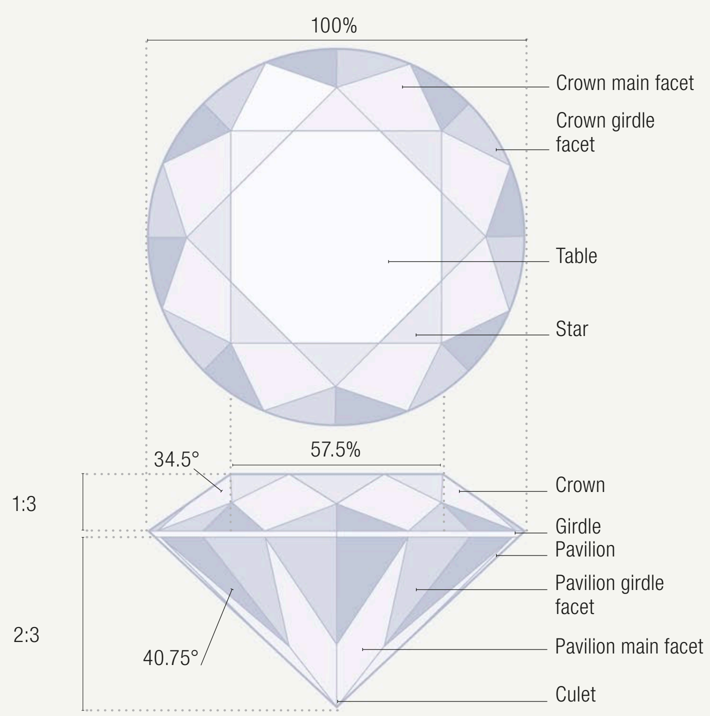
Polished stones

If a stone is described as "polished", it can be anything from a slice of opaque gem material polished on the flat sides for use as a pendant to the intricate and detailed carving of a fine cameo.

The parts of a gem

Jewel terminology

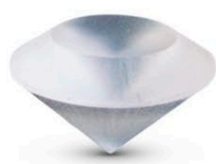
Whatever the gem cut being used, there are a few fundamental parts: the crown, pavilion, and table facet. The other facets and the proportion between the crown and pavilion affect a gem's brilliance. Whether on a round, brilliant, or rectangular emerald cut, the facets are given the same names and fill the same relative positions on the gem. The angles at which the facets are cut are determined by the refractive index, and the cutter uses a set of tables to find the suitable face angles for each type of material. The angles shown here are for diamond. The usual ratio of the crown to the pavilion is 1:3, but this can vary depending on the angle of the crown mains.



Cutting techniques

The basic stages of sawing, grinding, and polishing are common to all lapidary processes, but each of the three requires skills and tools unique to that particular step. It is not unusual for a gem cutter to be able to do all three.

Choice of rough A gem rough is chosen for its colour, size, clarity, shape, and freedom from flaws, fractures, and inclusions. If imperfections are present, the cut is oriented in such a way as to conceal them as much as possible.



Choice of cut The cut is chosen based on the shape of the rough, and the desired colour and brilliance of the finished stone. The rough is sawn to the general shape of the stone or to provide the table facet on the top half of the stone, called the crown.

Faceting begins The best brilliance is achieved when facets are angled and positioned correctly. Large facets are cut first. On a brilliant cut there are eight on the top and eight on the bottom. Usually the pavilion is faceted first, then the crown.

Further faceting Further smaller facets are added around the larger facets on the crown at the top and the pavilion at the bottom. On a brilliant cut there are 40 of these smaller ones. Each facet is cut to maximize its optical performance.

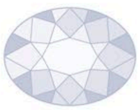
Finished off After all the final facets have been cut, the gem is then polished to remove any cutting scratches and to improve its lustre. This stage can take place alongside the faceting process – as preferred by most cutters – or afterwards.

Brilliant cut

Brilliant cuts maximize brilliance. They are also used on coloured stones to deepen their colour, conceal imperfections, and to even out patchy colour. Their facets, cut in a vertical direction from crown to pavilion, are roughly triangular or kite-shaped. The actual outline of the stone can vary from round to oval, to pendeloque, or even freeform, so long as the facets are triangular.


Brilliant round demantoid garnet


Brilliant round


Brilliant oval


Brilliant oval iolite

Cabochon

Gems cut with a flat back and a domed top are called cabochons. The dome itself can be flat, or high in proportion to the outline dimensions of the stone. The high dome is used to emphasize the particular optical properties of certain stones, such as asterism, iridescence, or a cat's-eye effect. When the gem has colour or pattern as part of its basic structure, the dome is usually shallower, in order to show off the colour or pattern to best effect. In terms of their outlines, cabochons can be virtually any shape.


Cabochon


Sodalite oval cabochon

Step cut

Step cuts are used to enhance the colour of a stone, although they generally produce less sparkle as a consequence. These cuts have rectangular facets in broad flat planes that resemble steps. The most widely used step cut is the emerald cut, which was originally designed to preserve valuable emerald rough. This is the preferred cut for brittle stones because it leaves them with no vulnerable sharp corners.


Square cut


Baguette


Emerald cut


Emerald-cut emerald

Mixed cut

Mixed cuts combine brilliant and step-cut facets, optimizing a stone's dimensions and visual properties to enhance the brilliance of a coloured stone, while still emphasizing its colour. The step-cut faces can be on the crown or pavilion. A mixed cut's outline shape can be virtually anything as long as the crown and pavilion display different cuts.


Cushion-cut heliodor


Mixed cut


Cushion cut


Mixed-cut topaz

Fancy cuts

Cuts with unusual outlines and facets are known as fancy cuts. Among these are hearts, free-form shapes with irregular outlines, kites, scissor, and pendeloque cuts, and standard shapes with unusual faceting – for example, where the facets form flat planes to create a chequer-board or zig-zag pattern. Gems cut into elongated ovals with pointed ends exhibit the marquise cut.


Garnet heart


Scissor cut


Pendeloque


Marquise cut


Marquise-cut blue diamond

Carving

In general, carving means the shaping of a piece of gemstone rough into a three-dimensional figure. It is a very skilled lapidary art that can take several forms. These include intaglios, or relief carving, with the figure carved into the gem; cameos, with a figure or scene in relief on a contrasting coloured background; or even full, three-dimensional figures, birds, and animals.


Cameo

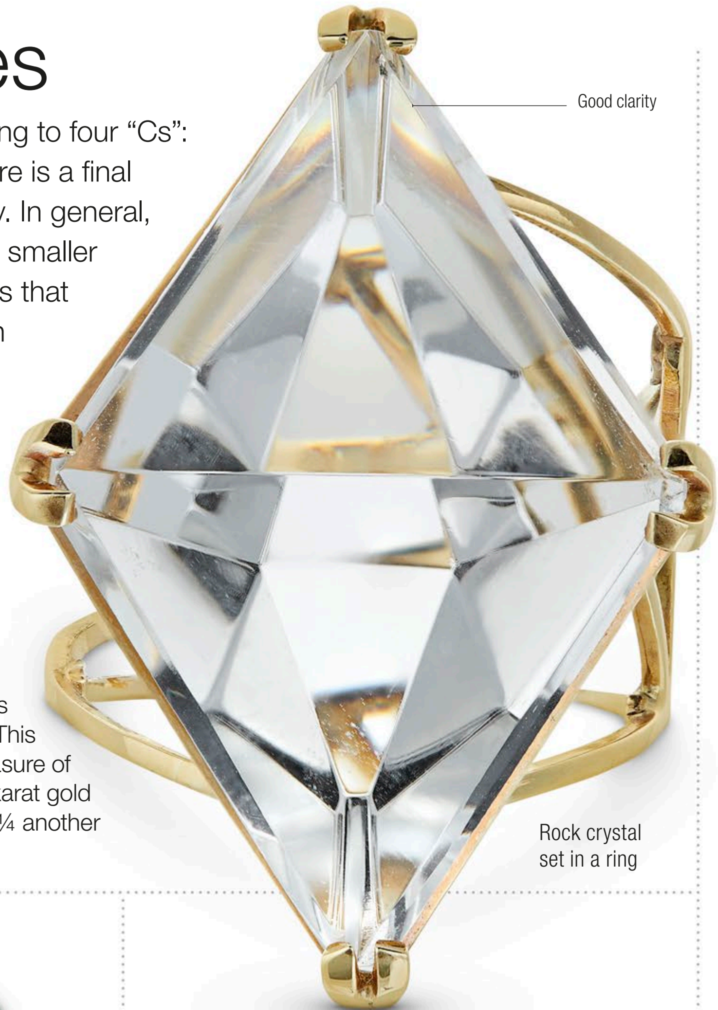

Carved coral cameo

The value of a gem

Whether they are collectable specimens, used in everyday jewellery, or incorporated into beautiful works of art, gemstones are viewed as highly prestigious objects in many – if not most – cultures. It could be argued that their value is entirely man-made, but the fact remains that fine gems represent an apex of material quality, visual beauty, and fine craftsmanship. Diamonds are graded and valued in a slightly different way from other stones (see p.27) – the term "coloured stones" refers to all non-diamond gems, although diamonds can be coloured – but the core principles remain the same.

Gem qualities

All gemstones are valued according to four "Cs": colour, clarity, cut, and carat. There is a final factor to add to these – their rarity. In general, larger stones are much rarer than smaller ones; for some stones, this means that an increase in weight can result in a disproportionately large price increase, so when a gemstone doubles in weight, its price may go up by four or five times.



Rock crystal set in a ring

Carat

A carat is a measurement of a gemstone's weight, equivalent to one-fifth of a gram. This should not be confused with karat, a measure of the proportion of gold in a gold alloy. 24-karat gold is pure gold; 18-karat gold is ¾ gold and ¼ another metal, often copper.

Goshenite showing excellent clarity

Clarity

Clarity refers to the lack of foreign matter – other minerals, hollows, or crystals – within the stone, known as inclusions. The resulting effect on the beauty of the stone determines value; although a lack of inclusions is valuable, certain types of inclusions are also desirable.

Aquamarine in a round cut

Cut

A gemstone's cut is graded on the basis of its technical perfection, and the brilliance it produces. Considerations might include whether the points of triangular facets meet without overlap, or if the sides of rectangular step-cut facets are parallel.

Sherry topaz in a deep gold colour

Colour

The value attributed to a gemstone's colour is usually determined by its purity and intensity. However, in some cases, it may be due to the rarity of a particular colour. For example, natural red or blue diamonds command astronomical prices.

Rarity

The fifth characteristic

Rarity has a direct effect on value: a superb garnet will never command the same price as an equivalent ruby, simply because ruby is vastly rarer. Some stones usually occur only in small sizes due to their chemistry. In this case, larger stones are even rarer.

Ruby

Enhancing gems

Many gemstones undergo treatment to enhance their natural characteristics in addition to the standard cutting and polishing processes that a lapidary will carry out. Gem sellers are expected to disclose any additional treatments a stone may have undergone. This is not only because a gem's value is based around its natural characteristics, but also because some treatments can also affect a gem's durability, or wear off. For example, the artificial coating of topaz gems (see right) can become scratched and wear off.

Tanzanite surface-coated to deepen and improve colour – before (left) and after (right)

Surface coating

Very thin coatings of gold, silver, and other metals can be applied to gems to alter their colour or reflectivity. This can be seen in varieties such as "mystic" topaz and "aqua aura" quartz. While attractive, these coatings soon wear off.

Coral bleached (above) then dyed (below)

Dyeing, bleaching, and staining

The staining and dyeing of gems is widespread. Slices of agate are routinely dyed with vivid colours such as blue or red – often using ordinary household cloth dyes, although there are also dyes specifically for stones. If a dye comes off a gem onto the hands, it is a sign of poor quality.

Collection of irradiated gemstones in various colours

Irradiation

A gemstone's colour can be altered by irradiation – bombardment with neutrons, gamma rays, ultraviolet light, or electrons, which is often followed by heat treatment. Most blue topaz on the market is irradiated and heat-treated colourless topaz.

Gemstones after being repaired by filling

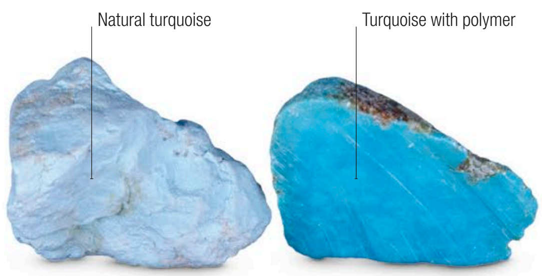
Filling, coating, and reconstruction

Some gemstones with cracks are subjected to fillers other than the oiling described for emerald. Fillers can be glass, resins, plastic, or waxes, and can be coloured to match the gemstone. Heat, pressure, or solvents are used to fuse together small pieces.

Imperial topaz crystal sawn in half: the crystal on the right was heated. Both colours are highly desirable

Heat treament

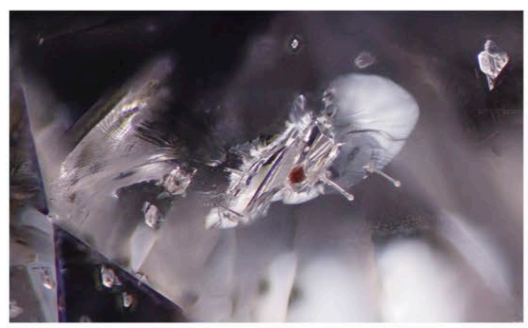
This is among the oldest forms of gemstone enhancement – zircons have been heat-treated to change their colour for at least a millennium. Today, the process is used to change colour or conceal inclusions.



Porous turquoise impregnated with a wax or polymer substance to colour and stabilize the material

Oiling

An old method of treating cracked emerald is simply to soak the stone in oil. This fills the cracks and makes the stone appear of a higher quality; however, it can give the gem an oily feel. Turquoise can also be soaked in polymer to improve colour.



Laser-drilled table facet – the drill holes have created a cleavage crack, worsening the flaw

Laser drilling

Diamond is combustible, a property that allows infrared lasers to drill tiny holes into the material to reach flaws and inclusions. Once reached, inclusions can be dissolved, and flaws can be filled with epoxy resins.

What is a jewel?

A jewel is a precious stone, usually a single crystal or part of a hard, lustrous or translucent mineral that has been cut or shaped for decorative use, and typically set into a metal or other precious material – either as jewellery to be worn or as an ornamental object. Jewels and jewellery have been created since prehistoric times and rank among some of the earliest known artefacts. In some cases, jewellery has originated in functional objects, such as brooches to fasten clothing. Some adornments had talismanic meaning, while in many cultures, jewellery and bejewelled objects were a means of storing wealth and indicating social standing. Below is a selection of jewellery and jewelled ornaments from prehistory to the modern world, covering a wide range of uses.

Mesolithic shell necklace
This necklace of snail shell beads found in Serbia is almost 10,000 years old, and is among early evidence of ornamental jewellery.

Egyptian falcon pectoral
Symbol of the sun god Horus, this gold, cornelian, and lapis lazuli pectoral is from the tomb of Amenemope, c.1000 BCE.

Babylonian gold pendant
One of a pair, this pendant from the 2nd millennium BCE represents the minor godddess Lama.

Chinese deer pendant
This 1st-millennium BCE animal carving is of highly prized nephrite.

Greek fibula
Found in Crimea, this hollow gold fibula (brooch) dates from c.425–400 BCE, and depicts a mythical hippocamp and griffin.

Byzantine brooch
This 6th-century CE brooch in the form of a Greek cross displays the Byzantine love of gold and precious stones.

Eagle pendant
This Renaissance gold pendant from c.1620 is enamelled and set with diamonds, rubies, and emeralds.

Art Nouveau hair comb
This 1904 ornamental poppy hair comb is made of horn, silver, enamel, and moonstones.

Elizabeth Taylor's charm bracelet
This circular-link gold bracelet was given to Elizabeth Taylor by her husband Richard Burton in the mid-20th century.

Transylvanian crown
Given by the Ottomans to Prince Stephen Bocskay of Transylvania in 1605, this crown is inset with turquoise, rubies, and pearls.

Spanish caravel pendant
The design of this enamel, gold, and malachite pendant from the 1580s reflects Spain's seafaring glory.

French necklace
This 18th-century silver necklace is set with topazes and amethysts. The ribbons, flowers, and bows are outlined by round zircons.

Naga bracelet
This piece from 2011 in the shape of a mythical Cambodian ocean guardian is set with a 12.39-carat purple tourmaline, diamonds, sapphires, and more.

1

Native elements

Winged brooch | This gold Verdura winged brooch, made in 1939, is set with two large and rare pink topaz stones surrounded by diamonds. The actress Joan Fontaine owned it and wore it in Alfred Hitchcock's film *Suspicion* (1941).

Gold? Yellow, glittering, precious gold? This yellow slave will knit and break religions, bless the accursed...

William **Shakespeare**
Timon of Athens

Gold

△ **Crystalline gold**, made up of of octahedral gold crystals

Even before gold became the trading medium of the commercial world and the foundation for modern money, it was prized for its beauty and spiritual significance. To the ancient Egyptians, gold was the perfect material – it offered a glittering yellow surface soft enough to work with, yet it was so durable that it would essentially last forever. In fact, of the three known metals stable enough to have been used for trade at that time, gold was the most suitable. It did not corrode and did not react with other substances. Unlike silver, it did not tarnish and, unlike copper with its high melting point, it could feasibly be melted into currency. Thus it became the most desired metal in the world, transcending geographical borders to become a universal symbol of power, both political and spiritual.

The colour of gold

In its pure state, gold is always golden yellow, but it is too soft to make into jewellery: to increase its hardness, gold is alloyed with other metals. Adding silver, platinum, nickel, or zinc creates pale or white gold. Copper yields red or pink gold, and iron gives a blue tinge. The purity of alloyed gold is expressed in karats, which measures parts per 24: for example, 18-karat gold means there are 18 parts gold out of 24 in the alloy, while 24-karat gold is pure (and mostly too soft to be worn). Note that “karat” is distinct from “carat”, a measurement of weight in gemstones.

Specification

Chemical name Gold | **Formula** Au | **Colours** Gold yellow
Structure Isometric | **Hardness** 2.5–3 | **SG** 19.3
RI n/a | **Lustre** metallic

Locations
1 Canada **2** USA **3** Brazil **4** South Africa **5** Russia
6 China **7** Australia (and many more)

Key pieces

Ancient gold | Because of gold’s chemically inert nature, ancient gold artefacts buried for thousands of years come out of the ground looking as bright as the day they were made. This Mycenean brooch is from c.1600–1100 BCE.

Roman gold | From the city of Pompeii buried by volcanic ash and lava in the 1st century CE, this gold armlet is in the form of a coiled snake and shows perfect preservation. The detail on the head and scales on the skin indicate high-quality craftmanship.

Cartier panther ring | This spectacular open-form, unisex ring in 18-karat yellow gold from the *Panthère de Cartier* collection features peridot eyes, an onyx nose, and lacquer accents. The wearer’s finger goes through the open mouth.

Rough

Placer gold | This is a gold nugget recovered from a stream gravel deposit known as a placer (Spanish for alluvial sand). The nugget shows a typical battered and rounded form.

Gold in quartz | This specimen mined directly from one of the veins in the Earth is an example of the form in which it naturally occurs – as scattered grains in quartz.

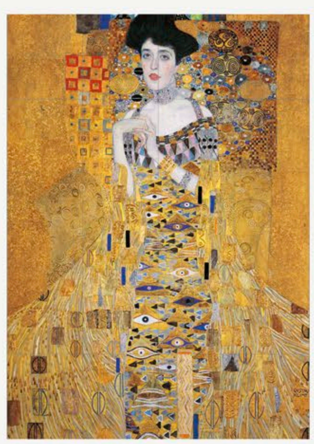
Grains of gold | Gold nuggets are relatively rare in stream gravels. Most stream gold is recovered in the form of small grains or flakes like these.

Gold nugget | The angular shape and rough texture of this nugget indicate that it has not moved far from the place where it weathered out (became exposed).

The woman in gold

The *Mona Lisa* of Austria

With its unusual mix of naturalistic face and skin and Egyptian-influenced, jewel-like decorative detail, this painting is not just painted to look like gold but also *with* gold in a powdered pigment form. When the Nazis seized this work in 1940, they changed the title to *The Woman in Gold* so they could display it without reference to its Jewish sitter. Its restitution was the subject of a film *Woman in Gold* in 2015.



Portrait of Adele Bloch-Bauer I
Gustav Klimt, 1907, 138 x 138cm (54 x 54in), oil and gold on canvas

Settings

Roman gold | The dolphin was a common motif in ancient Roman art. These large-eyed, drop dolphin earrings date from around the 1st century CE.

Scythian treasure | This elaborate gold pectoral was probably made by Greek goldsmiths in the 4th century BCE for a Scythian king in present-day Kazakhstan.

Cartier pen | Three views of this 2008 limited-edition Cartier gold pen show its dragon motif, set with 522 diamonds, six emeralds, and ruby eyes. The pen is finished in black lacquer.

When **gold** argues the case, **eloquence** is **impotent**

Publilius **Syrus**
Moral Sayings, 1st century BCE

Gold, diamond, and sapphire bracelet | This antique bracelet from France takes the form of a serpent. Its head is set with a sapphire ringed with diamonds.

Woodgrain necklace | This American gold necklace has an unusual woodgrain texture. The clasp is cleverly concealed in one of the oversized links of the chain.

Sunflower | This delicately sculpted sunflower is made from yellow gold. Its petals have been etched with fine lines to create a textured appearance, and cut stones have been set in its stamens.

Inca gold | Made in the 14th–15th centuries, this model llama from Peru is cast in high-karat gold. The animal's body has been pared down to simple geometric forms.

Charm bracelet | Bracelets like this one go in and out of fashion, but have the advantage of giving the wearer the chance to add personalized charms.

Cartier panther 18-karat gold rings | The top ring is in yellow gold with green garnet eyes; the bottom one in white gold is set with 158 diamonds and emerald eyes.

Bulgari triple-gold ring | Made by the house of Bulgari, this piece is composed of three rings of coloured 18-karat gold in different alloys – yellow, pink, and white.

Crown of Charlemagne | c.960 CE | Eight hinged plates of 22-karat gold with 144 *en cabochon* gems

△ **Front view** of the crown

Crown of Charlemagne

The Crown of Charlemagne is more than a jewelled medieval masterpiece – between the 10th and 19th centuries, it symbolized the might of the Holy Roman Empire, a vast European state with Germany at its heart. Later, the crown became such a powerful icon that the dictator Adolf Hitler used it in his campaign to create a new German-led empire in Europe in the 1930s.

Also called the Imperial Crown, or Crown of the Holy Roman Empire, it is named in honour of the first Holy Roman Emperor, Charlemagne I (Charles the Great), king of the Germanic Frankish tribes (c.747–814 CE). Although it is widely referred to as the Crown of Charlemagne, the surviving crown was probably made for the coronation of Otto the Great (912–73 CE), while it is thought that Charlemagne himself wore a simpler version for his coronation in 800 CE. Charlemagne was successful in conquering and unifying much of Western Europe and, after helping to put down a rebellion against Pope Leo III, was crowned Holy Roman Emperor by the grateful pope. The tradition of imperial rule continued until 1806, when the last Holy Roman Emperor, Franz II, dismantled the empire after military defeat by Napoleon. While Napoleon marched on Franz's base of Nuremberg, Franz moved the crown to Vienna for safekeeping.

Austrian 100-Euro coin depicting the Crown of Charlemagne

Now preserved in the national treasury in the Hofburg Palace in Vienna as part of the Austrian crown jewels – where it is still on public display to visitors – the Crown of Charlemagne is octagonal and is made from eight hinged panels of 22-karat gold. The panels are set with a dazzling range of 144 precious gems, including sapphires, emeralds, amethysts, and more than 100 natural pearls. Typical of Byzantine jewellery, the stones are rough cut, because faceting techniques had not yet been developed. Four of its panels feature scenes from the Bible depicted in *cloisonné* enamel (a form of painting laced with silver or gold wire), a technique that was also characteristic of the Byzantine era.

Coronation of Charlemagne by Pope Leo III in 800, shown in the *Grandes Chroniques de France* (1375–79) featuring an earlier version of the crown

Key dates

800 CE–1945

- **800 CE** Charlemagne is crowned the first Holy Roman Emperor
- **960 CE** The crown is made in a workshop in the Lower Rhineland of Germany
- **962 CE** Otto II is appointed Holy Roman Emperor and is the first to wear the crown
- **1424–1796** The crown and other imperial regalia are kept in Nuremberg
- **1796** The crown is taken to Vienna to save it from falling into Napoleon's hands
- **1806** Franz II relinquishes his title as the last Holy Roman Emperor
- **1871** The heraldic symbol of the German Empire is created, inspired by the crown
- **1938** Nazi forces invade Austria and take the crown back to Nuremberg
- **1945** At the end of World War II, American forces return the crown to Austria

Holy Roman Emperor Otto II

Silver

△ **English sterling-silver** christening mug of Edward VIII, in Art-Deco style

Both gold and silver have been used as currency for thousands of years, and although gold has become synonymous with wealth, silver is now increasing in value because of its scarcity. Since pure silver is easily damaged, jewellers work with sterling silver, which has copper added for strength. Silver in folklore is often related to the moon, a link made much of by silversmiths including legendary Danish designer Georg Jensen, who worked in the early 20th century. Since then, silver has grown in demand for use in both jewellery and industry.

Specification

Chemical name Silver | **Formula** Ag | **Colour** Silver
Structure Cubic | **Hardness** 3.25 | **SG** 10.1–11.1
Streak Silver-white | **Locations** Mexico is the greatest single producer; also Peru, USA, Canada, Norway, Australia, Russia, Kazakhstan

Rough

Wiry silver | Most silver in the ground is extracted from ores but, in its native state, silver can also appear as a coarse mass of tendrils. Here, it is growing in quartz.

Polished silver and copper slice | Native copper and native silver can sometimes form together in a single specimen, commonly known in the USA as a "half-breed".

Tarnished silver | The surface of silver is susceptible to tarnishing, which appears as a coating over the surface when exposed to oxygen or hydrogen sulphide, as here.

Silver dendrite | Some silver crystals grow in a dendritic (branching) formation, which has formed a naturally tree-like structure in this specimen.

Settings

Moonlight brooch | Georg Jensen likened silver to the glow of the moon, and here he combines sterling silver with moonstones in an Art Nouveau design.

Silver fish | This 1940s sterling silver bracelet by Margot de Taxco is in the shape of a koi. De Taxco lived and worked in Mexico, the world's top silver-producing country.

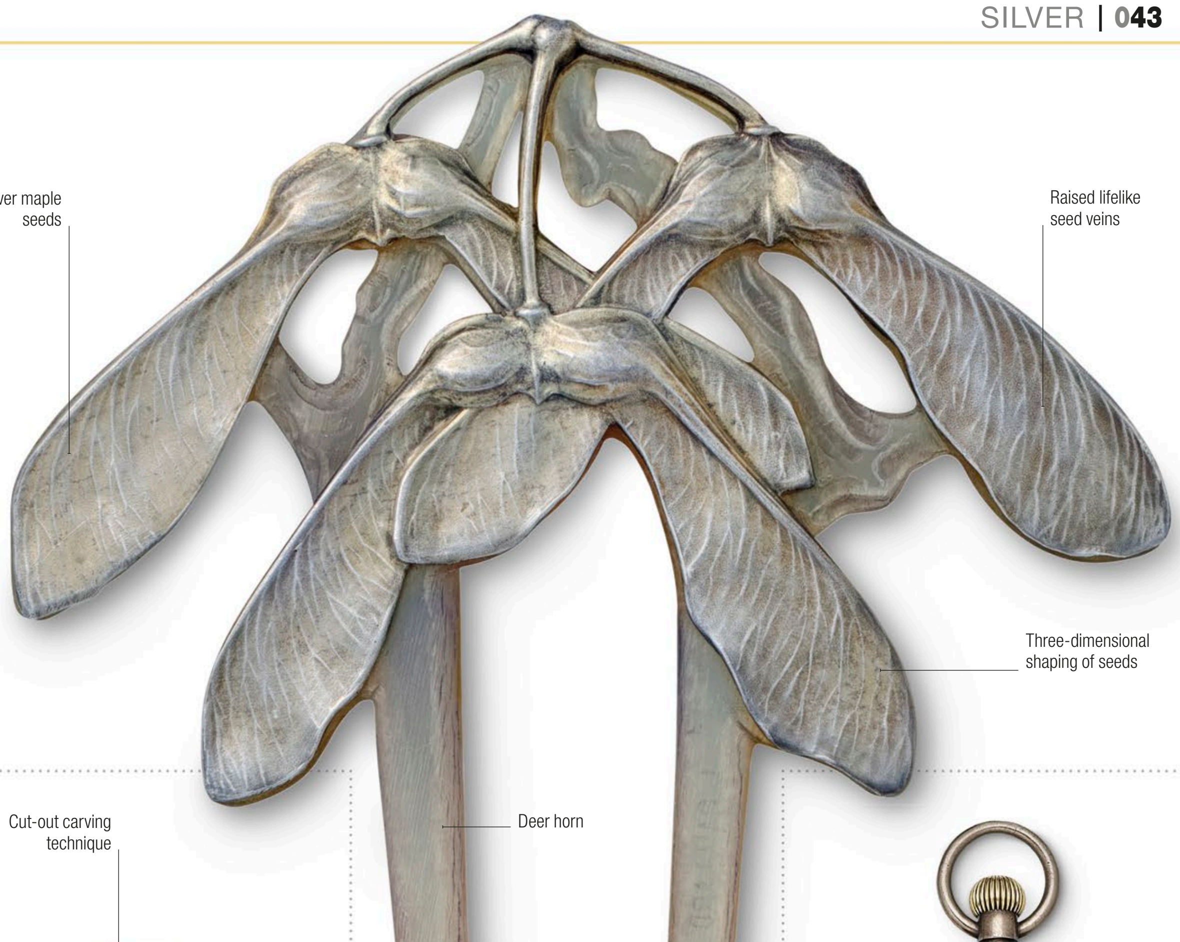
Silver in industry

Demand outstrips supply

Silver is naturally more abundant than gold in the Earth's crust, but over the past 20 years, stocks have dwindled dramatically due to the fact that it has become highly sought after in manufacturing for its exceptional ability to conduct both heat and electricity. Silver is a key component in photovoltaic panels for solar power, a growing sector that will only increase the demand for silver as an industrial commodity. It is also used in the production of almost all electronic devices, from circuit boards and TV screens to mobile phone batteries and computer chips. A mobile circuit board typically contains about 300mg of silver.

Mobile phone circuit board Silver is used in circuits such as this.

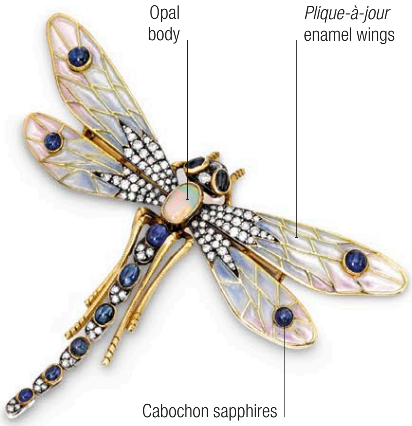
Silver artefacts have been discovered that date back to around 4000 BCE



Aquamarine brooch | This 18th-century brooch, with a 4.80-carat aquamarine, follows the era's fashion for colourful stones set in silver with decorative elements.

Silver brooch | Arno Malinowski designed this for Georg Jensen in the late 1950s. His work often featured deer: here, the animal's lifelike form is set amid stylized foliage.

Silver Swiss pocket watch | From the 16th century onwards, silver and gold replaced steel as the preferred metals for pocket watches. This one has a split-second dial.

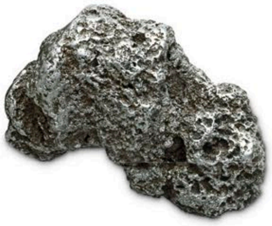


Dragonfly brooch | This brooch features a mixture of silver and gems. The dragonfly's articulated tail is made up of diamonds set in silver and sapphires set in gold.

Swing drop earrings | Featuring a pair of baroque pearls, these drop earrings also consist of blackened, 14-karat gold, silver, and brilliant-cut diamonds.

Hair comb | Lucien Gaillard's comb from c.1902–06 is an example of the fashion for silver in the early 20th century. Silver was seen as both modern and functional.

Antique pansy brooch | Made in France, this colourful vintage brooch is made from silver with gold, amethyst, diamonds, and enamel.



Platinum

△ **Piece of platinum** in its natural state

When Spanish conquistadors in Columbia first found platinum in the 16th century, they called it platina, meaning “little silver”. To them it was worthless, a distraction in their search for gold. Today, however, it is one of the most precious metals on Earth, both due to its scarcity and its properties as a catalyst, speeding up chemical reactions while remaining inactive itself. As well as its use in fine jewellery, it is a vital component in converting crude oil into petroleum, and also plays a role in reducing pollution from cars as a form of filter (see box below).

Specification

Chemical name Platinum | **Formula** Pt | **Colours** White, silver grey, steel-grey | **Structure** Isometric (cubic) | **Hardness** 3.5 | **SG** 21.45 | **RI** 2.19 | **Lustre** Metallic | **Streak** n/a
Locations South Africa, Russia, Canada

Rough

Grains of platinum | Platinum grains occur naturally but usually include traces of other metals including iron, palladium, rhodium, and iridium.

Embedded in rock | When platinum is found as grains, flakes or thin layers in silicate rock, as in this example, it is typically mixed with other minerals and has to be separated out.

Platinum nugget | Although most platinum occurs naturally as grains, it is only rarely found in nugget form. Platinum nuggets such as this do not tarnish.

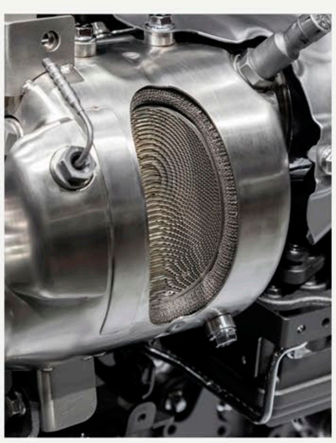
Settings

Eternity ring | Jewellery firm De Beers invented the idea of the diamond eternity ring in the 1960s – the platinum version is the most valuable of their range.

Reducing gas

Catalytic converters

Platinum reduces pollutants from car engines by converting poisonous gases into less harmful substances. Since 1974, when the USA introduced new laws on air quality, catalytic converters in vehicles have become a worldwide phenomenon. Catalytic convertors use platinum to minimize the emission of noxious gas from engines – the platinum catalyst rips apart the toxic nitrogen dioxide and allows the molecules to re-form in less toxic combinations.



Platinum at work This cross-section of a catalytic converter shows the platinum grains it contains.

Sperrylite crystal | Sperrylite is a compound of platinum and arsenic, and is valued by collectors as a specimen rather than an ore of platinum.

Traces of platinum from around 1200 BCE have been found in ancient Egyptian tombs

Solid necklace | Designed in the London workshop of Leo De Vroomen, this platinum necklace is inspired by the organic lines of the Art-Nouveau movement.

Knot ring | This 1960s diamond and platinum ring with a knot-shaped setting is designed more for show than wearability, with a complex design and large centre stone.

Cartier watch | Skeletonizing the movement of this Rotonde de Cartier platinum watch takes up to 200 hours by hand, with another 200 hours for assembly.

Solitaire ring | Cartier launched the solitaire in 1895. Since then, its platinum and diamond solitaires such as this example have become a benchmark for engagement rings.

Key pendant | The brilliant white colour of platinum is evident in this Tiffany & Co. Quatra pendant, which also features white diamonds in a brilliant cut.

Art-Deco brooch | Platinum jewellery was the metal of choice for fashionable women in the early 20th century. This geometric design is set with diamonds and sapphires.

Chandelier earrings | Made around 1915–20 by Marcus & Co., these earrings in an Art-Deco style feature round-cut diamonds in a platinum setting.

Openwork bracelet | This substantial openwork bracelet from France is inlaid with 411 diamonds set in platinum. It was made in around 1935.

Diamond pear-drop earrings | c.1770s–1780s | 14.25 and 20.34 carats | Made in France, probably by court jewellers Boehmer and Bassenge

Marie Antoinette's **diamond earrings**

△ **Marie Antoinette** pictured wearing the earrings

Reigning as the queen of France alongside King Louis XVI from 1774 to 1792, Marie Antoinette was the most glamorous woman in Europe in the 18th century, setting trends that were slavishly followed by fashionable ladies of the royal courts. Her extravagance provided fuel for the satirical newspapers of the day, and her love of fine clothes and jewellery earned her the nickname "Madame Déficit".

Among her indulgences were up to 300 dresses a year, countless pairs of perfumed gloves, and a hoard of sparkling jewellery. Some of it was made from paste (heavy flint glass) but much of it was real, including a favourite of the queen – a pair of diamond earrings with pear-shaped drops, one weighing 20.34 carats, the other weighing 14.25 carats. Thought to be a gift from Louis XVI, and commissioned from jewellers to the French court Boehmer and Bassenge, the earrings are believed to have passed down through the French royal family following Marie Antoinette's death by guillotine in 1793 during the French Revolution. They resurfaced some 60 years later as a wedding gift from Napoleon III to Empress Eugénie, who was fascinated by, and modelled her style on, Marie Antoinette. After Eugénie was exiled to England in 1871, the earrings were sold to a Russian aristocrat, who in turn sold them to jeweller Pierre Cartier in 1928. In the same year, they were bought by American socialite Marjorie Merriweather Post, and in 1964 her daughter donated them to the Smithsonian Institution in the US, where they can still be seen in the Gem Gallery.

Portrait of Empress Eugénie, who received the earrings from Napoleon III as a wedding gift, and sold them after Napoleon's defeat in the Franco-Prussian War in 1871

> Every woman wanted to **imitate the queen.** Everyone rushed to get the **same jewellery**

Madame **Campan**
First lady-in-waiting to Marie Antoinette

Key dates

1755–1964

1725

1755 Marie Antoinette is born in Vienna, 15th child of the Empress of Austria, Maria Theresa

1750

1770 Marie travels to France to marry Louis Auguste, grandson of King Louis XV

1774 Louis Auguste takes the throne; Marie becomes queen

1775

1774–89 During their reign, Louis presents Marie with the pear-drop diamond earrings

1793 Marie Antoinette dies at the guillotine; her earrings remain in the French royal family

1800

1853 Napoleon III gives the earrings to Empress Eugénie to celebrate their marriage

1850

1870–72 Empress Eugénie is thought to sell the earrings to Duchess Tatiana Yousupoff of Russia

1900

1928 Pierre Cartier buys the earrings and sells them to Marjorie Merriweather Post

1959 The diamonds are mounted into replica settings by jewellers Harry Winston

1950

1964 Post's daughter, Eleanor Barzin, donates the earrings to the Smithsonian Institution

2000

Napoleon III

Copper

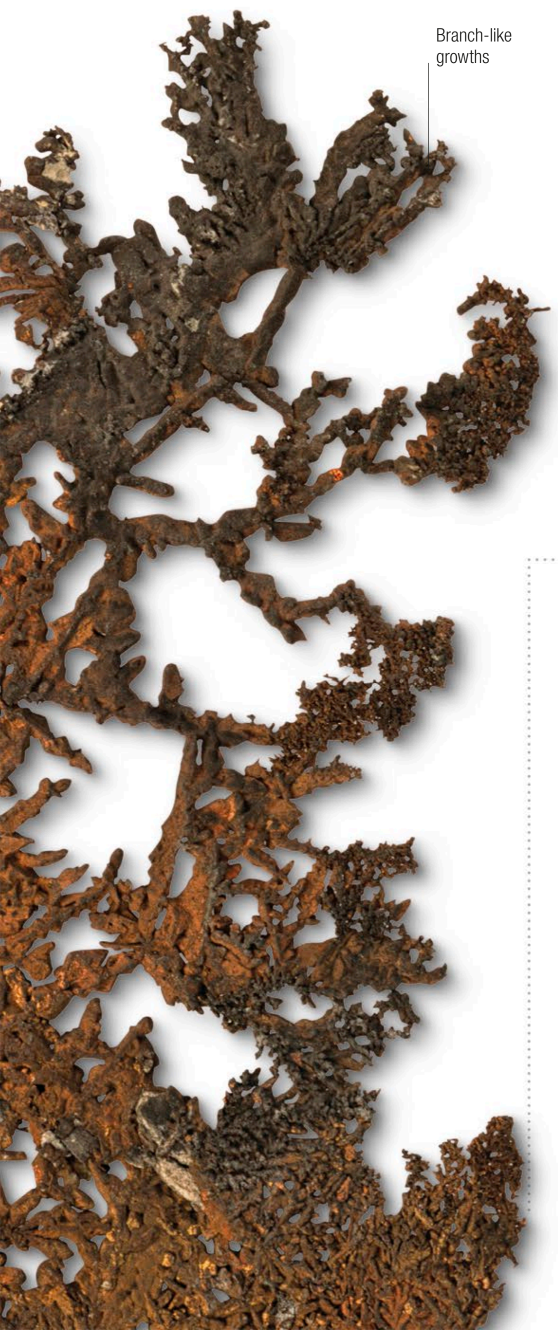
△ **Sample of the mineral bornite**, a principal ore of copper

Copper was the first metal to be used by humans – it naturally occurs in its pure form, and was used in early casting and decorative arts; it also forms a part of bronze, which was the first purposefully made alloy. Copper jewellery has been worn for millennia, and is popular in alternative medicine. It is also an extremely effective electrical conductor: this property, and the fact that it is extremely resistant to corrosion, have made copper the most widely used material for electrical wiring in the modern age.

Specification

Chemical name Copper | **Formula** Cu | **Colours** Orange-red | **Crystal system** Cubic | **Hardness** 2.5–3.0 | **SG** 8.89 | **RI** 2.43 | **Lustre** Metallic | **Streak** n/a
Locations Chile, USA, Indonesia

Rough



Dendritic copper | The most dramatic form of native copper, dendritic copper occurs when copper crystals form thin, branching, fern-like sheets such as this.

Native copper | In this mixed rocky specimen, thin, leaf-like sheets of native copper are interlayered with a piece of quartz groundmass.

Cast

Cast sphere | This bead of pure copper has been cast in the form of a sphere. Material such as this would be suitable for smelting or re-casting.

Four-sided jar | This bronze, four-sided *fanghu*, or square jar, originates from China c.475–221 BCE. It was decorated with green malachite, most of which is now lost.

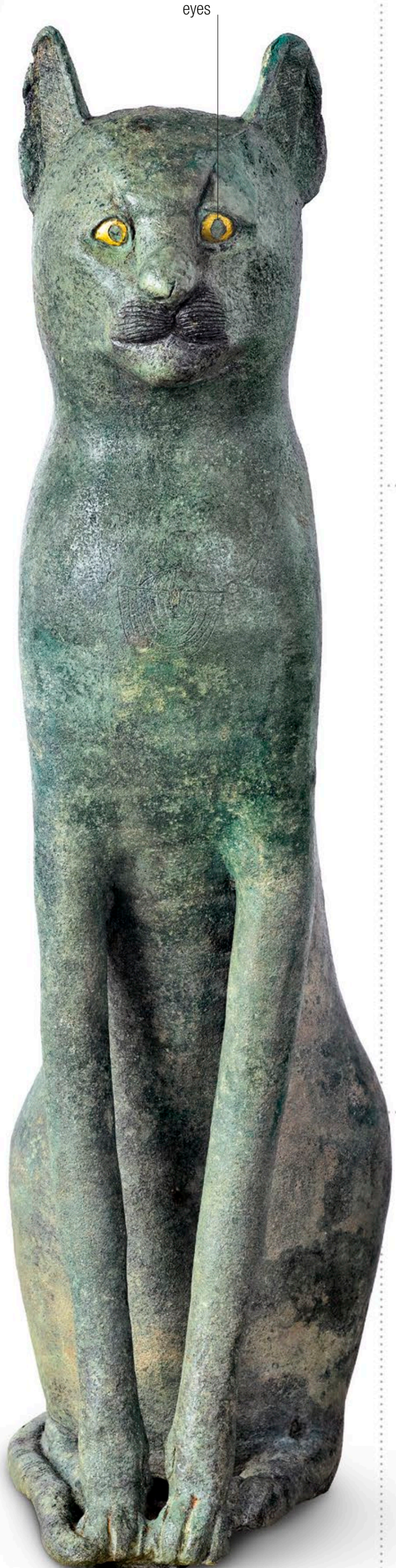
Copper jewellery is said to protect against health problems

Copper alloy brooch | This Anglo-Saxon bird brooch made of a copper alloy was found at Bekesbourne Anglo-Saxon cemetery, UK. It originates c.5th–8th century CE.

Etruscan bronze | Made around 599–500 BCE, this cast Etruscan bronze amulet is in the form of two opposite-facing oxen with a common body.

Anatolian bronze | This gilt-bronze figurine from the first millennium BCE features a man riding a lion. It is probably based on an image from Anatolian mythology.

Chinese bronze | This classically ornamented cast bronze wine jar with a lid originates from the Western Zhou dynasty, which ended in 771 BCE.



Statue of Bast | The Egyptians revered cats as gods and had a temple dedicated to them at Bubastis on the Nile Delta. This 22nd-dynasty bronze represents the goddess Bast.

Bronze armour | This 3rd–2nd-century BCE armour is made from overlapping bronze plates, originally stitched or riveted to a leather jerkin.

Edo bronze | Originating from the Edo (Bini) people of Nigeria around 1520–80, this hollow-cast bronze head depicts a conquered king.

Roman brooch | This 1st-century CE Roman bronze brooch – one of a pair – was found in the UK and features elaborate swirling ornamentation.

Statue of Liberty

Icon in copper

Liberty Enlightening the World, known as the Statue of Liberty, stands on Liberty Island, New York, USA. It was designed by French sculptor Frédéric Auguste Bartholdi, built by Gustave Eiffel, and dedicated in 1886. Its "skin" consists of around 90,800kg (200,000lb) of copper, 2.3mm ($\frac{3}{32}$in) thick – at the time, the largest single use of copper in the world. Originally, the statue was a dull copper colour, but later developed a green patina from oxidation. After investigation, it was decided that the patina should remain and actually helped to protect the exterior.

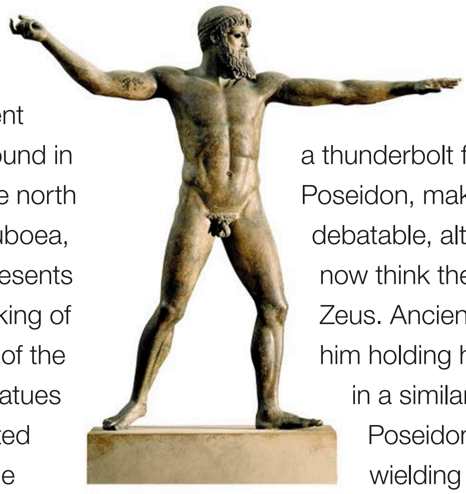
Statue of Liberty The iconic statue consists of copper plates attached to a rigid iron frame.

Artemision Bronze | 460–c.450 BCE | 2.09m (6ft 10in) | Hollow cast bronze figure of Zeus or Poseidon | Severe style from the Classical period of ancient Greece

Artemision Bronze

△ **Head of the statue** showing finely rendered hair

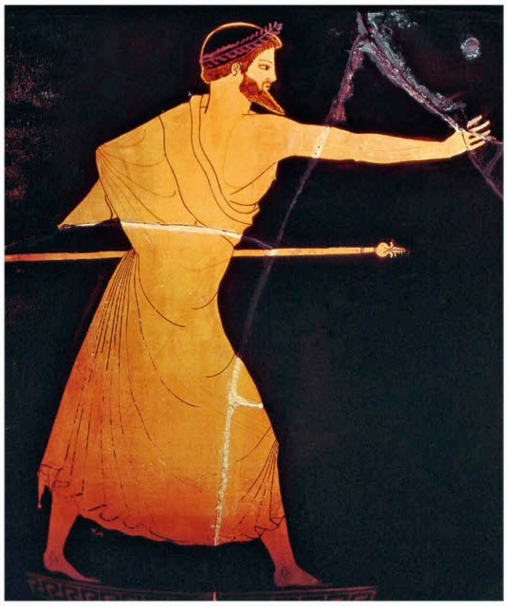
The Artemision Bronze is an ancient Greek sculpture found in a shipwreck off the north coast of the Greek island Euboea, in the Mediterranean. It represents either the Greek god Zeus, king of the gods, or Poseidon, god of the sea. Most ancient bronze statues have since been lost or melted down, making this one all the more precious.



Front view of the bronze statue

Dating from 460–c.450 BCE, the nude bronze figure stands at 2.09m (6ft 10in). It shows the realistic anatomy of the Greek Classical period, though the arms are disproportionately long, exaggerating the dramatic pose. The wide stance and extended arms – one poised to hurl a weapon and the other taking aim – suggest great power about to be unleashed. An object missing from the right hand, either a thunderbolt for Zeus or a trident for Poseidon, makes the god's identity debatable, although most scholars now think the sculpture represents Zeus. Ancient Greek pottery shows him holding his thunderbolt aloft in a similar stance, whereas Poseidon is normally depicted wielding his trident downwards.

The shipwreck that contained the statue was first discovered by sponge divers in 1926, and a subsequent salvage operation by the Greek navy recovered the Artemision Bronze in two pieces, along with various other treasures. However, the exploration was called off in 1928 after a diver died, and it was never resumed, despite the wreck lying only 40m (130ft) below the surface. It is thought that the ship may have been of Roman origin, bringing back looted treasures from Greece to Italy. Ironically, the statue was saved and preserved for future generations after it ended up on the bottom of the sea.



Pottery figure of the Greek god Zeus, thought to be from around 500 BCE, depicted holding a spear or javelin in place of his customary thunderbolt

Key dates

460 BCE–2015

500 BCE

460–450 BCE The statue is made in ancient Greece using a hollow bronze cast technique

250 BCE

150 BCE The statue sinks aboard a ship in the Mediterranean

0

1900

1926 Sponge divers accidentally find the shipwreck at Cape Artemision and the statue is retrieved

1928 The Greek navy abandons the salvage after a diver dies from the bends; the object held by the statue is never recovered

1925

Sponge diver in the early 20th century

1950

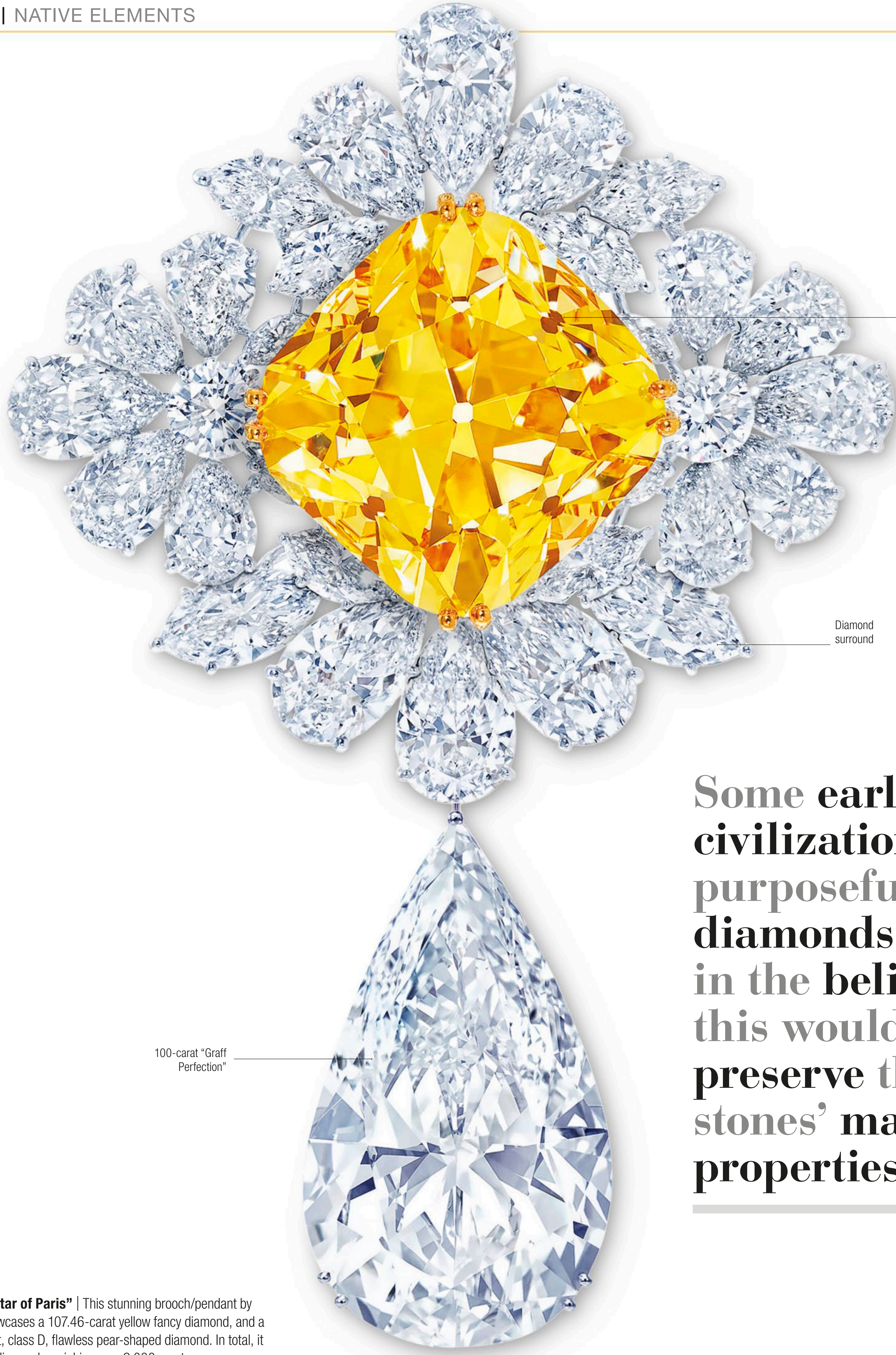
1975

2015 The Artemision Bronze continues to reside at the National Archaeological Museum of Athens where it is one of the highlights of the museum

2000

The bearded god once hurled a weapon held in his right hand, probably a thunderbolt, in which case he is Zeus

Fred S. **Kleiner**
Author



"Royal Star of Paris" | This stunning brooch/pendant by Graff showcases a 107.46-carat yellow fancy diamond, and a 100-carat, class D, flawless pear-shaped diamond. In total, it contains diamonds weighing over 2,000 carats.

Some early civilizations purposefully left diamonds uncut in the belief that this would preserve the stones' magical properties

Diamond

△ **Platinum ring** set with yellow and white diamonds

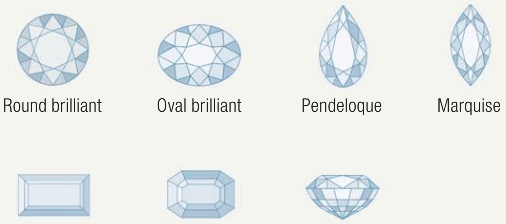
With exceptional beauty, lustre, and sparkle, diamond is the most iconic of all precious stones and highly prized in jewellery all over the world. However, this is only one of its uses. Industrial diamond is a vital component in oil drilling, specialist scalpels, tool manufacturing, and many other industries, all of which use the supreme hardness of diamonds for cutting tools and abrasive powders. There is no firm boundary between gem-grade and industrial-grade diamonds – around 80 per cent of the diamonds mined each year are unsuitable for gemstone wear, and find other uses in industry. However, very small or lower-grade stones can be polished into gemstones rather than being used in industry.

Discovering diamonds

For over 2,000 years, diamonds were found only as crystals in river gravels, and, until 1725, India was the major source. As Indian production waned, diamonds were discovered in Brazil, and in 1867 they were found in gravels near the Orange River in the Kimberley region of South Africa. Further exploration there revealed volcanic pipes of a previously unknown rock type containing diamonds; this was named kimberlite and was recognized as the diamond source rock. Its discovery formed the basis of the modern diamond industry. Many similar pipes have since been found in other African countries, Siberia, Australia, and more recently in Canada, China, and the USA.

Specification

Chemical name Carbon | **Formula** C | **Colours** All colours | **Structure** Cubic | **Hardness** 10
SG 3.4–3.5 | **RI** 2.42 | **Lustre** Adamantine
Streak None



Locations
1 Canada **2** USA **3** Brazil **4** Ghana **5** Angola **6** Namibia **7** Botswana **8** South Africa **9** India **10** Russia **11** Borneo **12** Australia

Key pieces

Dresden Green | Probably from the Kollur Mine in India, this 41-carat natural green diamond is named after its home in Dresden, Germany (see pp.140–41). It is famous for its extraordinary green colour and is set in a lavish hat ornament.

Cullinan I | Originally part of a 3,106.75-carat rough stone from which several gems were cut (see p.54), the Cullinan I is part of the British crown jewels. At 530.1 carats, it is the largest polished white diamond in the world.

Allnatt Diamond | Weighing 101.29 carats, this extraordinary stone is described as a fancy vivid yellow and is set in a platinum flower design. It is named after one of its former owners, businessman and art collector Alfred Ernest Allnatt.

Rough

Rough diamonds | Diamond crystals can be found in a number of external forms, all related to their cubic structure. Here, they have formed rough cubes.

Carbonado | This specimen consists of carbonado, a distinct cryptocrystalline variety of diamond originating from Brazil and Central Africa.

Perfect octahedron | The majority of diamonds found are crystallized as octahedrons, as here. Originally, only the crystal faces were polished.

Cullinan rough model | This is a model of the largest diamond ever found – the Cullinan (see p.53). It weighed 3,106.75 carats and was the size of a potato.

> **We had with us salted birds... we placed the gem on them, they became animated and flew away**
>
> Reference to diamonds in the Babylonian Talmud

Colours

Blue Heart Diamond | This natural blue diamond, cut into a heart shape, originated in the diamond fields of South Africa. It weighs 30.62 carats.

Brown diamond | Brown diamonds originate mainly from Australia, and, as seen in this pendaloque-cut gemstone, tend to lack the brilliance of diamonds in other colours.

Brilliant cut | Looking downward through the table of this brilliant-cut diamond, the clarity of the stone and the reflectivity of its facets can be seen.

Deep green | This green diamond has been cut into a pendaloque. Its intense hue suggests it may have undergone colour enhancement (see box, right).

Oppenheimer Diamond | One of the largest uncut diamonds in the world at 253.7 carats, this perfectly formed curved octahedron is a natural yellow stone.

Cut

Classic-cut diamond | Seen side-on, all of the facets of this champagne-coloured diamond are visible, either directly or through the stone.

Fancy cut | This triangle-cut diamond is technically a fancy cut, in that it has a number of extra, non-standard faces added to what is otherwise a brilliant cut.

Blue emerald cut | The cutter of this diamond has chosen an emerald cut in order to enhance its blue tinge, but still retain its brilliance.

Mixed cut | This white diamond has had a number of extra faces added to the pavilion of a scissors-cut crown to increase the sparkle under the table.

Emerald cut | Even though the stone is small, the emerald cut of this gem has enhanced the steely sheen that this diamond possesses.

Fancy heart | Hearts are the most difficult shape to facet because of the faces in the top notch. The cutter of this stone has achieved the heart shape with great skill.

Standard brilliant | This diamond has been cut in the "standard" 58-facet brilliant cut, specifically developed to maximize the brilliance, or "fire", of a diamond.

Diamond enhancement

Bringing out the best

"Fancy" (coloured) diamonds demand high prices if the colours are definite and intense. Reds, violets, and blues bring the highest prices. They are not always what they seem. Today, a number of processes exist to change the colour of white diamonds, from irradiation to flooding them with gases that are absorbed and produce colour change. Other enhancements include laser drilling to remove inclusions and the application of sealants to fill cracks. Buyers should always purchase diamonds certified by a legitimate testing agency.

Marquise-cut blue Only a gemologist can tell if the colour of this stone is natural.

Settings

Victoria-Transvaal Diamond | This 67.89-carat, pear-shaped, brownish-yellow stone was originally part of a 240-carat rough stone discovered in the Transvaal, South Africa. The Victoria-Transvaal Diamond Necklace has appeared in a Tarzan film.

Diamond earrings | This pair of gold foliate diamond earrings features a large diamond as each flower head, and diamond-set leaves.

Floral spray brooch | Set in 18-karat gold, this floral brooch has aquamarines for the flower centres, and diamonds for the leaves and petals.

Platinum owl brooch | This whimsical brooch is made out of platinum. The owl features yellow diamond eyes, a body set with pavé-cut diamonds, a black coral beak, and gold claws. The gem-encrusted bird rests on a black coral "branch".

Butterfly brooch | Made by jewellery artist Cindy Chao, this brooch is set with 2,138 gems, including large diamonds in the wings. These have been faceted on one side only.

Owl brooch | Made of platinum and yellow gold, this variation on the whimsical owl theme has an intricate pavé diamond head and body, and large pearl accents for chest and perch.

An ancient test for a diamond was to place the stone on an anvil and strike it with a hammer: if it broke, it wasn't a diamond

Panther brooch | From the "Panthère de Cartier" series, this white gold panther brooch is set with hundreds of small diamonds, an onyx nose, and enamel spots.

Trinity ring | This platinum trinity ring is set with a large solitaire-mounted central diamond and numerous small diamonds bleeding off onto the band.

"Buckle" ring | The central bezel of this ring has been designed to resemble a buckle. The band and bezel are both set with round and baguette-cut diamonds.

"Ribbon" brooch | Devised as a pair of ribbons passing through a circular buckle, this brooch is set with one large diamond and numerous smaller ones.

Briolette diamond brooch | Created for Van Cleef & Arpels, this phoenix brooch is set with diamonds and sapphires, with a 96.62-carat diamond in its beak.

Spider stick pin | Made around 1900, this Art Nouveau stick pin is crafted in the form of a spider, and is set with a 0.80-carat champagne diamond.

Cullinan III and IV brooch | The diamonds in this platinum brooch are two of the smaller stones cut from the world's largest diamond, the 3,106-carat Cullinan (see pp.53 and 54).

The Orange

A natural rarity

Orange-coloured fancy diamonds are noted of their rarity, and mostly occur only in smaller sizes. As a result, this gemstone caused a stir when it was put up for sale. At the time of its auction in 2013, The Orange was claimed to be the largest fancy vivid orange diamond in the world – estimated to be 14.82 carats. Its size, beauty, and rarity were reflected in its price, and it was sold by Christie's auctioneers in Geneva for over $35 million.

Bright, natural colour The Orange is unusual for its combination of fine colour and large size.

Koh-i-noor | Oval brilliant-cut diamond | 105.6 carats | Seen here set in the centre of the crown of Alexandra of Denmark (1844–1925), wife of King Edward VII

Koh-i-noor diamond

△ **Replica of the Koh-i-noor** (centre) in its original cut and setting

The Koh-i-noor ("Mountain of Light") diamond, like many famous gems, had a turbulent history. Mined in southern India, the stone was initially referred to in 1526 in the memoirs of Babur, the first Mogul king of India. It was a spoil of war, and it continued to change hands between kings over the course of several centuries, which may go some way towards explaining its reputation for being cursed, as whoever owned the huge diamond was a target for attack.

Queen Elizabeth the Queen Mother, wearing the Koh-i-noor in a simple version of her crown

By the time five-year-old Duleep Singh came to power in 1843 as the last ruler of the Punjab and Sikh Empire, the diamond belonged to him, as the previous four maharajas had been assassinated while in possession of the stone. Just a few years later, the British dismantled Singh's kingdom, and the Koh-i-noor transferred to British ownership as part of the treaty that incorporated the Punjab into the British Empire. Presented to Queen Victoria in London in 1850, the diamond was apparently accompanied by a curse that read: "He who owns this diamond will own the world, but will also know all its misfortunes. Only God or Woman can wear it with impunity".

Far more controversial than the supposed curse was the criticism that the 186-carat gem looked dull due to poor cutting. Prince Albert decided to have the diamond recut in 1852, drastically reducing its size to 105.6 carats but eliminating several flaws in the process and creating an oval brilliant cut. Since then, the recut Koh-i-noor has been set in four different crowns, each worn by British queens, including Queen Alexandra, Queen Mary, and Queen Elizabeth the Queen Mother.

Koh-i-noor diamond (centre) in Queen Elizabeth the Queen Mother's crown

Only God or Woman can wear it with impunity...

Curse said to have accompanied the Koh-i-noor

Key dates

1100–2015

1100

1100–1300 The diamond is thought to have been mined in southern India

Maharaja Duleep Singh

1500

1526 The diamond is first documented in the memoirs of the Mogul king, Babur

1600

1800

1850 Duleep Singh, last maharaja of the Punjab and Sikh Empire, presents the jewel to Queen Victoria

1850

1851 On display at the Great Exhibition in London, the diamond is criticized for being dull

1852 The Koh-i-noor is recut into an oval brilliant at Prince Albert's behest

1902 The diamond is set into the coronation crown of Queen Alexandra

1900

1937 Elizabeth (the late Queen Mother) wears the diamond at the coronation of her husband, George IV

1947 Newly independent India requests the diamond's return

1950

1976 Prime Minister Zulfikar Ali Bhutto lays claim to the diamond for his country, Pakistan

2015 A group of Indian investors launch legal proceedings for the diamond's return

2000

ANCIENT EGYPT

Clothing in ancient Egypt was drab by modern standards: it was typically off-white, the natural colour of linen. It is not surprising, then, that the Egyptians adorned themselves with vividly-coloured gems such as amber, turquoise, lapis lazuli, and carnelian, although a glass-like, glazed ceramic known as Egyptian faience was also used. Gems were showcased in wide semi-circular collars worn by both men and women, with counterweights hanging down their backs to keep the jewellery in place. Wigs were popular, and richly ornamented headpieces and circlets kept them from slipping. Earrings, bracelets, and amulets were also worn by all classes, further enhancing a wearer's appearance.

Gems had great spiritual significance as well, and were often worn for protection, to ward off evil, or to attract the attention of good spirits. Red stones such as carnelian and red jasper were considered powerful because of their resemblance to the colour of blood, which stood for life and longevity. Greenish-blue turquoise from the Sinai represented fertility, healing, and rebirth, while deep blue lapis lazuli from Afghanistan was especially significant, symbolizing the heavens, death, and the afterlife.

Gold, carnelian, and feldspar Egyptian necklace, c.1991–1786 BCE

Egyptian guests at a banquet This wall painting from the tomb of Nebamun, an Egyptian offical who lived in the 18th dynasty, around 1350 BCE, depicts banquet guests with the women wearing elaborate gowns and wigs, and decorated with precious jewels.

Hope Diamond | 25.6 x 21.78 x 12mm (1 x ¾ x ½in) | 45.52 carats, cushion antique brilliant, fancy dark greyish-blue with whitish graining present

Hope Diamond

△ **Hope Diamond** in its necklace setting

The Hope Diamond is celebrated first and foremost for its stunning colour and size. It weighs 45.52 carats and is the world's largest deep blue diamond to date. Its extraordinary colour is caused by the mineral boron: most natural blue diamonds contain tiny particles of boron, averaging fewer than 0.5 parts per million (ppm), but areas of the Hope Diamond have as many as 8ppm. It also glows red under ultraviolet light.

Adding to its aura of mystery, the Hope Diamond is said to carry a curse – various figures from its history have suffered ill fortune, including Marie Antoinette, guillotined in the French Revolution, and American heiress Evalyn Walsh McLean, who was struck by a catalogue of misfortunes. She bought the gem in 1911 and suffered bereavement, divorce, and bankruptcy. Its last private owner, jeweller Harry Winston, posted it to the Smithsonian, its current owners, paying $155 in insurance, but even the postman who delivered it attracted ill luck – he was allegedly hit by a truck.

King Louis XV of France, a former owner of the diamond

For all the accursed tales surrounding it, the Hope Diamond has an illustrious, royal provenance. Discovered in an Indian mine in the 18th century, it was originally a larger stone weighing 115 carats. It was called the Tavernier Diamond after its first owner, Jean-Baptiste Tavernier. He sold it to Louis XIV, who had it cut. The larger part was a 67.12-carat heart-shaped diamond known as the French Blue. This gem, inherited by Louis VI and Marie Antoinette, was stolen during the French Revolution but surfaced in London in 1812 as a smaller, recut gem. The diamond was documented in 1839 owned by Henry Philip Hope, who gave it its name – then died in the same year.

American heiress Evalyn Walsh McLean, pictured wearing the Hope Diamond in its necklace setting, and whose personal misfortune fuelled rumours of a curse

Brilliant colours … all are found enclosed in a morsel of pure carbon

Charles **Blanc**
Author

Key dates

Mid-1600s–1958

1650

Mid-1600s French merchant Jean-Baptiste Tavernier acquires a crudely cut diamond in India. It weighs around 115 carats

1668 Tavernier sells the diamond to French king Louis XIV, who cuts it into a smaller gem, known as the French Blue

1700

The Order of the Golden Fleece pendant

1749 Louis XV has the Rose de Paris diamond set within the ornate pendant necklace, The Order of the Golden Fleece, by jeweller Andre Jacquemin

1750

1800

1830 Henry Philip Hope buys the diamond in London from the estate of George IV of England

1850

1887 Henry Hope's heir, Lord Henry Hope, inherits the gem; he is forced to sell it in 1901 to pay off his debts

1868 Wilkie Collins writes *The Moonstone*, a work of fiction about a cursed gem, based on the Hope Diamond

1900

1911 Jeweller Pierre Cartier sells the diamond, after resetting it in a headpiece, to Edward and Evalyn Walsh McLean

1949 New York jeweller Harry Winston buys the diamond, along with the rest of Mrs McLean's jewels

1950

1958 Harry Winston Inc. donates the diamond to the Smithsonian, sending it by registered first-class mail. It can still be seen there today

2000

2

Gemstones

Pyrite

△ **Pyrite crystals** in the form of pentagonal dodecahedrons, also called pyritohedrons

Known since antiquity, pyrite is better known by its informal title, "fool's gold". Its name is derived from the Greek word *pyr*, meaning "fire", because pyrite emits sparks when struck by iron. Nodules of pyrite have been discovered in prehistoric burial mounds: the sun-like colour of pyrite probably assured its value. In later times, polished slices of its crystals were set edge to edge on wooden backing to make mirrors. Today, pyrite is polished as beads, and its bright crystals are themselves mounted as gemstones.

Specification

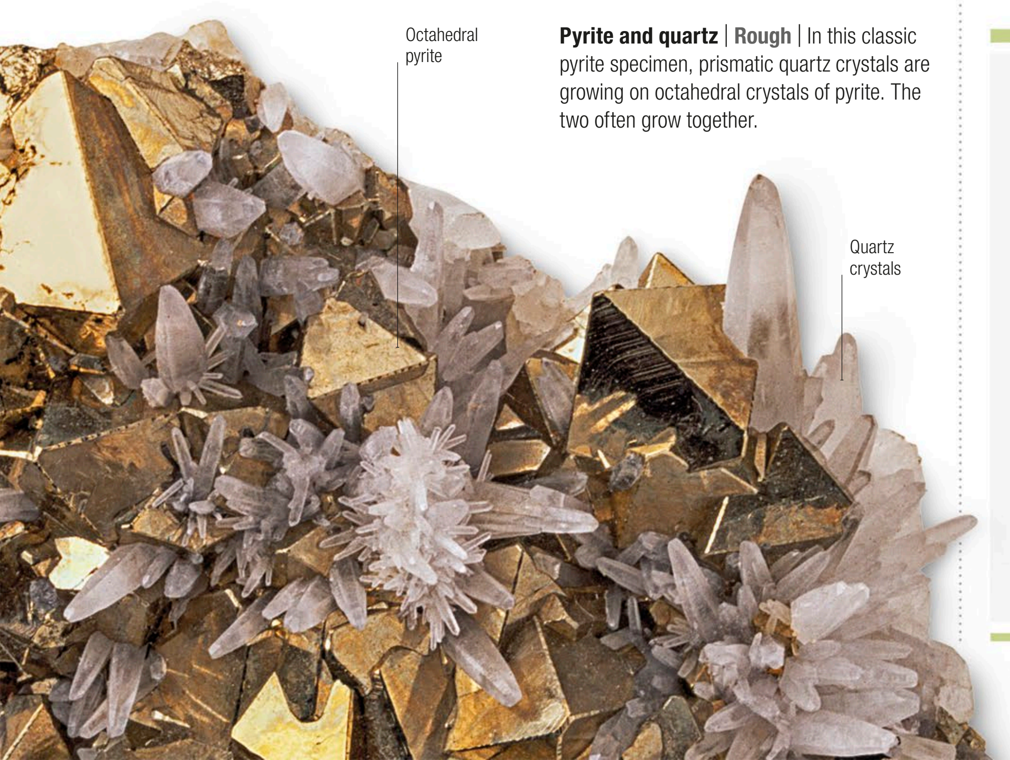
Chemical name Iron disulphide | **Formula** FeS_2
Colours Pale brass-yellow | **Structure** Cubic | **Hardness** 6–6.5
SG 5.0–5.2 | **RI** 1.81 | **Lustre** Metallic | **Streak** Greenish-black to brownish-black | **Locations** Spain, South America, USA, Japan, Italy, Norway, Greece, Slovakia

Spanish pyrite | **Rough** | The source of this specimen – Almira, Spain – is famous for its abundance of pyrite. These well-formed cubes are in a lime-rich mudstone matrix.

Pyrite crystal | **Rough** | This dazzling, neatly cuboid pyrite crystal offers a good demonstration of how the mineral can form in its natural state.

Modified crystals | **Rough** | The pyrite crystals in this excellent specimen have developed into the form of cubes modified by octahedrons.

Pyrite necklace | **Set** | The spherical beads of this necklace are made of highly polished pyrite, finely crafted even though pyrite is brittle and difficult to work.



Pyrite and quartz | **Rough** | In this classic pyrite specimen, prismatic quartz crystals are growing on octahedral crystals of pyrite. The two often grow together.

Marcasite

Pyrite in disguise

Marcasite is a mineral that, in all likelihood, has never been used as a gemstone. However, the name is widely used to refer to both it and pyrite. So-called marcasite jewellery, popular in Victorian times, has always been made mainly from pyrite, since some genuine marcasite is chemically unstable and rapidly deteriorates in air. Although marcasite is chemically identical to pyrite, it has a different crystal structure.

Cut "marcasites" This mass of rose-cut "marcasites" – actually pyrite – are ready for setting.

Sphalerite

△ **Ruby blende**, a red variety of sphalerite

Sphalerite gemstones are rare. This is not because the stone itself is rare, but because it is possibly the most difficult of all gems to cut. The stone can easily shatter into small pieces during cutting: the ability to facet sphalerite is the mark of a master cutter. For this reason, stones are faceted only for collectors. Sphalerite takes its name from the Greek *sphaleros*, meaning "treacherous", referring to the fact that it occurs in a number of forms that can be mistaken for other minerals. Its usual colour is greenish yellow, but it can also be ruby red.

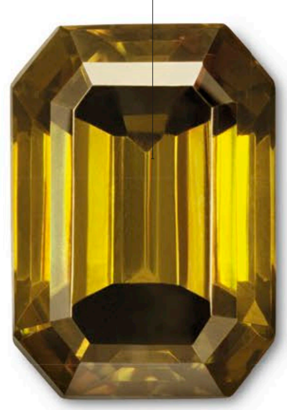
Specification

Chemical name Zinc sulphide | **Formula** ZnS
Colours Yellow-green, red, brown, black | **Structure** Cubic
Hardness 3.5–4 | **SG** 3.9–4.1 | **RI** 2.36–2.37 | **Lustre** Resinous to adamantine | **Streak** Brownish to light yellow
Locations Russia, Spain, Mexico, Canada, USA

Baryte on sphalerite | **Rough** | This specimen consists of a mass of elongated, platy baryte crystals resting on a bed of sphalerite crystals.

Gem sphalerite | **Rough** | Here, a large, gem-quality sphalerite crystal can be seen embedded in smaller crystals of sphalerite and quartz.

Faceted oval | **Cut** | The superb cut of this oval sphalerite gemstone brings out one of the mineral's more unusual colours, a deep red hue.



Emerald cut | **Cut** | Because of sphalerite's extreme brittleness, stones with corners of any kind are difficult to cut, so this emerald-cut gem displays exceptional craftsmanship.

Scissors cut | **Cut** | The cutter of this sphalerite gem has used the complexity of a modified scissors cut to help disguise the stone's internal colour variations.

Stuart Sapphire | Approx 3.8 x 2.5cm (1½ x 1in) | 104-carat, oval-cut fine blue sapphire

Stuart Sapphire

△ **Edward I of England**, who took the stone in 1296

Historians are not sure where the Stuart Sapphire came from, or of the identity of its first owner. What is certain, however, is that the gem has represented the might of Scotland and its royal family for hundreds of years. The 104-carat, oval-cut sapphire has a fine blue colour and is drilled at one end, indicating that it has been worn in a pendant at some point in its history. It was named after the Stuart monarchs who united England and Scotland under their reign from 1603 to 1741. Before then, there is some evidence that it belonged to the first king of Scotland, Alexander II, and was set into his coronation crown in 1214.

Passed down through generations of Scottish royals, the sapphire is officially noted in the possession of the Stuart King James II when he ruled England and Scotland. Historians generally agree that when James II fled England in 1688, bound for France, he took the sapphire with him.

Medieval kings wore [sapphires] around their necks as a defence from harm

Beth **Bernstein**
Author

A century later, the sapphire was back on English soil in the possession of King George III.

By the time George's granddaughter Victoria came to the throne in 1837, the stone had become the centrepiece of the Imperial State Crown and was used for her coronation a year later. The sapphire took pride of place at the front of the crown until 1909 when it was moved to the back to make way for a stunning newcomer, the Cullinan II, cut from the largest diamond ever found. The Cullinan II and the Stuart Sapphire are now joined by a band studded with eight emeralds, eight sapphires, and two rows of pearls.

James I and VI, first King of England and Scotland, portrayed here c.1620 by Paul van Somer. King James owned the sapphire during his reign

Key dates

1214–1909

1200

1214 The sapphire is set into the crown of Scottish king, Alexander II

1296 Edward I of England takes the sapphire when he invades Scotland

1300

c.1360–70 Edward III returns it to his brother-in-law, David II of Scotland

1371 David II's successor Robert II becomes the first Stuart king and now owns the stone

1400

Oliver Cromwell, Lord General of the parliamentary armed forces in 1650

1500

1603 The sapphire passes to Robert II's descendant, James I, who moves to England to become king

1600

1649–50 Oliver Cromwell sells the sapphire; it is later returned to Charles II

1688 James II takes the sapphire with him into exile in France

1700

1838 The sapphire is set into the front of the Imperial State Crown for the coronation of Queen Victoria

1800

1909 The sapphire is moved to the back of the crown and replaced with the Cullinan II diamond

1900

Bismarck sapphire necklace | This necklace was created in 1959. The sapphire was originally set in a choker by Cartier in 1927. The stone hangs from a chain of baguette and round brilliant-cut diamonds.

> **Sapphires** possess a **beauty** like that of the **heavenly throne;** they denote… those whose lives **shine** with their **good deeds** and **virtue**

Marbodius **of Rennes**
11th-century bishop and poet

Sapphire

△ **Rough sapphire** showing colour gradation

Both ruby and sapphire are gem varieties of the same mineral, corundum, an aluminium oxide that is next to diamond in hardness. Although commonly thought of as blue, sapphire can also be colourless, green, yellow, orange, violet, and pink, among other hues. Before the end of the 19th century, when geologists realized that sapphires of all colours were the same mineral, terminology regarding the naming of the gem persisted from medieval times: green sapphire was called Oriental peridot and yellow sapphire was Oriental topaz. One of the oldest known stones clearly identified as sapphire is St Edward's Sapphire: it is believed to date from the Anglo-Saxon king Edward the Confessor's coronet in 1042.

Fancy sapphires

With three exceptions, modern terminology simply uses the word "sapphire" preceded by the colour of the stone – for instance, yellow sapphire or green sapphire. Two exceptions are the rare pink-orange stones that are called padparadscha (Sanskrit for "lotus blossom"), and sapphire that appears blue in daylight and reddish or violet in artificial light, which is called alexandrine or alexandrite sapphire. The third exception is blue sapphire, which is simply called "sapphire". Colours other than blue are often referred to as fancy sapphires. Many sapphires, whatever their colour, have microscopic inclusions of rutile that produce a star when cut *en cabochon*.

Specification

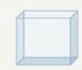
Chemical name Aluminium oxide | **Formula** Al_2O_3
Colours Most colours | **Structure** Hexagonal, trigonal
Hardness 9 | **SG** 4.0–4.1 | **RI** 1.76–1.77 | **Lustre** Adamantine to vitreous | **Streak** Colourless

Round brilliant

Oval brilliant

Cameo

Step cut



Slab

Cabochon

Locations
1 Montana, North Carolina, USA **2** Colombia **3** Brazil **4** Kenya **5** Malawi **6** Sri Lanka **7** India **8** Kashmir **9** Thailand **10** Vietnam **11** Australia

Key pieces

Russian pectoral cross | Made in the Kremlin workshops in Moscow, Russia, during the second half of the 16th century, this cross was designed to be worn as a chest ornament. The central sapphire has been carved in the shape of Christ on the cross.

Logan sapphire | This flawless stone is the second largest known sapphire. The large table of the cushion cut shows the naturally perfect interior of this gem, which is set in a brooch surrounded by 20 round brilliant-cut diamonds.

Cartier clip brooch | The Duchess of Windsor revived the popularity of sapphires in the 1950s when she wore this clip. The sapphire is set in white gold and platinum, and smaller sapphire cabochons are used for the panther's spots.

Rough

Colourless rough | This crystal has the classic corundum prismatic shape, with a triangular termination. Colourless sapphire may also be described as white.

Sapphire rough | This unusually large rough specimen of sapphire, around 22mm (1in) in length, displays a fine deep blue colouring. It also shows a number of imperfections.

Sapphire gravels | These uncut sapphires come from Philipsburg, Montana. For sheer volume, the US state of Montana is the world's most prolific producer of sapphires.

Padparadscha | The rare pink-orange variety of sapphire has its own name, as opposed to being described by its colour. Most padparadscha comes from Sri Lanka.

Jean Harlow

Sapphire on the screen

According to Hollywood legend, actress Jean Harlow accepted leading man William Powell's marriage proposal in 1936, but refused his offer of a diamond ring. The platinum-blonde bombshell felt that a large star sapphire would better suit her personal style, and Powell duly purchased one. The ring can be seen in the romantic comedy *Personal Property*, as Harlow wore it on set during her performance – the last of her tragically curtailed career.

Jean Harlow Harlow's sapphire engagement ring can be seen in this still from the film *Personal Property*, 1937, the year she died.

Cut and colour

Oblong step | A large table brings out the colour of sapphire. Blue is the most highly prized hue, and is given its colour by traces of titanium and iron.

Oval-cut green sapphire | Green is often found to be bands of yellow and blue sapphire, but skilful cutting of unevenly coloured stones yields gems with a uniform appearance.

Mixed-cut yellow sapphire | Skilful cutting reveals this stone's even yellow colour, its transparency enhanced by the brilliant cut that accentuates highlights and shadows.

Colourless brilliant cut | Colourless sapphires are often cut with multiple facets to catch the light and make the most of their adamantine or vitreous (glassy) lustre.

Synthetic sapphire | This oblong stone features a brilliant cut. Once faceted, this variety of synthetic sapphire shows a full tonal range of pinks.

Star of Asia | Some sapphires such as this display asterism, a star-like pattern seen when cut *en cabochon*. It is caused by tiny intersecting inclusions of rutile.

The sapphire shall be as blue as the great sea

Oscar **Wilde**

Settings

Cluster ring | This dramatic cluster ring features a central, oval-cut sapphire displaying its classic blue colouring, surrounded by a cluster of diamonds.

Conchita sapphire butterfly | This versatile ornament can be worn as a brooch, pendant, or clasp. It shows the rainbow of sapphire colours, all found in Montana, USA. Most Montana sapphires are heat-treated to intensify the original colours.

Flower brooch | The petals of this distinctive gold brooch consist of pink sapphires, while the stem and centre of the flower are set with diamonds.

Sapphire and diamond brooch | This openwork brooch is based around a 9.32-carat central sapphire, framed by an old-cut diamond scalloped surround.

Sapphire set ring | This twisted silver ring has multiple sapphires on one curve overlaying clustered diamonds set into the other curve, creating a contrast of colour and shine.

Yellow sapphire ring | This striking dress ring is composed of 49 yellow sapphires set in a square grid pattern, ringed with smaller diamonds.

Danish ruby parure | 1804 | Rubies, diamonds, gold | Necklace, tiara, earrings, brooch, bracelet, worn by Queen Ingrid of Denmark, c.1960s (ring later added by Crown Princess Mary)

Danish ruby parure

△ **Ruby ring** from the parure in its current form

The Danish ruby parure is a breathtakingly beautiful set of jewellery, with a royal pedigree that stretches back over 200 years. Its story begins with the coronation of Napoleon I in 1804. To ensure that this was a spectacular occasion, he gave all his marshals funds to buy new jewellery for their ladies. Among them was Jean Bernadotte, who commissioned the parure for his wife, Désirée Clary. Both were commoners at this point, but Bernadotte was later elected heir to the Swedish throne, and Désirée became Queen Desideria (see pp.108–09). The parure passed into the Danish royal family in 1869, when Princess Louise received the jewels as a wedding present. Although Swedish herself, she was marrying the future King Frederik VIII of Denmark. The gift was deemed particularly appropriate as the diamonds and rubies echoed the colours of the Danish flag. The parure currently belongs to Crown Princess Mary of Denmark.

The showpiece of the parure is the stunning wreath tiara, composed of diamond-encrusted leaves and ruby "berries". The small rubies have been cleverly set in clusters, so that they appear larger. Their colouring is light, nearer to pink than blood-red, but it has been claimed that this makes them more wearable, especially with blue or purple ensembles.

Napoleon I crowns his wife Josephine as empress in a painting by Jacques-Louis David, 1807

The precise make-up of the parure has varied over the years. Originally, the leaves were hair ornaments, and they were only modelled into a tiara in 1898. There have since been two major restylings, in 1947 and 2010. In these, the tiara has been made more compact, while the girandole earrings and necklace have been modified, to allow them to be worn with different accessories.

Key dates

1804–2010

1800

1804 Désirée Clary wears the ruby parure at the Coronation of Napoleon Bonaparte

1829 Désirée is crowned Queen Desideria of Sweden

1850

1869 Princess Louise receives the parure as a wedding gift

1898 The ruby parure is split up, with the tiara passing to Alexandrine of Mecklenburg-Schwerin

1900

1926 Queen Louise dies and the tiara is reunited with the rest of the parure

1935 Alexandrine gives Princess Ingrid the parure when she marries Prince Frederik

1947 Ingrid enlarges the tiara by adding two brooches from the parure

1950

2000

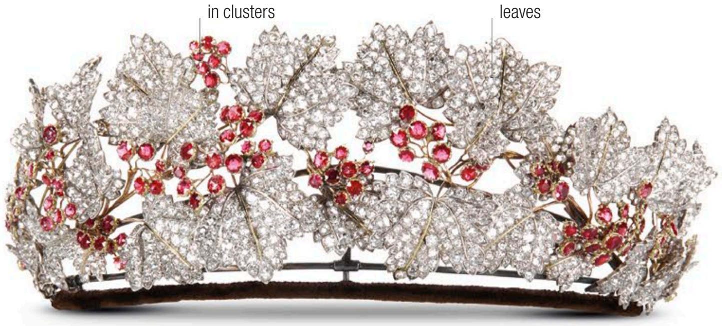
2004 Crown Princess Mary wears the rubies for the first time (acquiring it as a wedding gift)

2010

2010 The parure is remodelled by the jewellery company Marianne Dulong

2020

Crown Princess Mary of Denmark with the parure



Tiara from the parure featuring leaf shapes set with diamonds, interspersed with "berry" clusters composed of rubies

> I see the **natural beauty** of the stones… I look at **colours, sharpening, brightness**

Per **Dirksen**
Goldsmith, on the remodelling of the tiara

Ruby

△ **Mid-20th century ruby** earrings set with 18-karat gold and diamonds

Ruby is the red variety of the mineral corundum, and its colour seamlessly picks up where pink sapphire stops. Only darker stones are generally called rubies, but the distinction between ruby and pink sapphire can be a matter of opinion. Ruby is sometimes tinged with purple, and the most valued colour is known as pigeon-blood red. It has been mined from the gravels of Sri Lanka since at least the 8th century BCE, the subject of speculation from its earliest days. Ancient Hindu and Burmese miners thought pale pink sapphires were unripe rubies.

Specification

Chemical name Aluminium oxide | **Formula** Al_2O_3
Colour Red | **Structure** Trigonal | **Hardness** 9 | **SG** 4.0–4.1 | **RI** 1.76–1.78 | **Lustre** Vitreous | **Streak** Colourless
Locations Myanmar, Sri Lanka, Nigeria, Thailand, Australia, Brazil, Kashmir, Cambodia, Kenya, Malawi, Colombia, USA, and more

Rough

Raw ruby | This gem-quality crystal has the horizontal striations that indicate changes in its growing environment. Ruby ranges from deep cochineal like this to pale rose-red.

Tapering crystal | This prismatic, gem-quality ruby crystal of good colour retains a segment of the matrix in which it grew at the base.

Crystals in rock | Displaying the gemstone in its natural state, this specimen of rock groundmass is host to a number of prismatic Kashmir ruby crystals.

Cut

Brilliant cut | The faces of this round brilliant ruby illustrate one of the four Cs (colour, clarity, cut, carats) that contribute to a gem's quality – in this case, a perfect cut.

Star ruby | The high-domed oval cabochon, good, intense colour, and clearly defined star markings place this star ruby among the finest examples.

Ruby is the solitary and glowing eye which dragons and wyverns carry in the middle of their foreheads

Bishop **Marbodius**
(11th century)

Settings

Carmen Lúcia Ruby | At 23.10 carats, this is the largest faceted ruby in the United States National Gem Collection. It is also one of the finest large, faceted Burmese rubies known. High-quality Burmese rubies larger than 20 carats are exceedingly rare. The stone was mined from the fabled Mogok region of Myanmar in the 1930s.

Floral brooch | This intricate gold brooch takes the form of a spray of flowers, set with rubies and sapphires (both varieties of corundum) and diamonds.

Gold ring | The unusual hexagonal bezel on this ring is set with two rows of rubies, two rows of diamonds, and a large central diamond.

1930s earrings | A total of 64 calibre-cut rubies are set in this ribbon and circle motif, with two central round-cut diamonds and 34 more baguette and round-cut diamonds.

Navette ring | Dating from around 1910, this Edwardian platinum and gold ring is topped with a diamond-set flower in a field of rubies framed with diamonds.

Dragon pendant | In keeping with ancient traditions, this pendant takes the form of a dragon with a ruby for an eye. The setting consists of white gold and diamonds.

Ruby and diamond ring | The pendeloque ruby set in this platinum ring, surrounded by 10 diamonds, has the slight purple tint called "pigeon's blood".

Red gemstones

What's in a name?

The name "ruby" has been applied to a number of red gemstones throughout history including garnets (see pp.258–63) and spinels (see pp.80–81) – Balas ruby was once another name for spinel. It was only through the development of chemistry and mineralogy in the 19th century that distinctions could be scientifically made. Today, many rubies are heat treated to improve their clarity or colour. There are also synthetic rubies available, but their value is a tiny fraction of the real thing.

Emerald-cut synthetic Despite the good colour and clarity typical of synthetic rubies, their value is low.

Timur Ruby | 352.5 carats | Shown here in its necklace setting, in a photograph of Queen Elizabeth II by Cecil Beaton (1953)

Timur Ruby

△ **Timur Ruby**, in the necklace made for Queen Victoria

Of the Royal Crown Jewels of Britain, there is one exceptional gem that is not what it seems, an impostor that passed through the hands of the rich and powerful for hundreds of years. Until 1851, it was the largest known ruby in the world, but at the time of its documented discovery in 1612, and for hundreds of years afterwards, no one was aware that the Timur Ruby was not a ruby at all, but a spinel.

It was only in the latter half of the 19th century that gemologists began to differentiate between the two. The mistake, however, was understandable. Rubies and spinels look almost identical, and share a similar chemical composition and hardness. What separates them is the way in which they refract light – rubies are doubly refractive, while spinels are singly refractive. When light enters a ruby, it is split in two and each beam travels at a different speed. In contrast, when light enters a spinel only one beam of light is generated – an unusual characteristic that is also shared by diamonds and garnets.

Despite its changed classification, the Timur Ruby remains a highlight of the British Crown Jewels. It is named after the Mongol ruler who conquered Delhi in 1398, and who is believed to have taken the gem during the invasion. Returned to India in 1612, the gem was passed down through generations of Mughal emperors, each of whom inscribed their name on its surface. During Britain's annexation of India in the late 1840s, the Timur Ruby and other spinels were shipped to England and presented to Queen Victoria, who openly admired "the wonderful rubies".

Timur, one of the last great conquerors of the Eurasian steppe, pictured holding his crown

[It] is the largest in the world, therefore even more remarkable than the Koh-i-noor

Queen **Victoria**
1851

Key dates

1398–20th century

1300

1398 The Mongol sultan Sahib Timur invades Delhi, India, and takes the ruby

1600

1612 The Indian Mughal Emperor Jahangir is given the Timur Ruby by Shah Abbas I of Persia

Portrait of Indian Mughal Emperor Jahangir

1700

1739 The ruby is stolen by Persian ruler Nadir Shah during an attack on Delhi

1747 The ruby is looted by Nadir Shah's commander Ahmad Shah, later king of Afghanistan

1800

1810 The ruby is returned to India when Ahmad Shah's grandson, Shah Suja, is forced into exile in the Punjab

1840

1849 During the annexation of Punjab territory, Britain takes the ruby from the Lahore Treasury

April 1853 Garrard sets the gem into a necklace for Queen Victoria

1850

1851 The Timur Ruby is presented to Queen Victoria, and is reclassified as a spinel in the same year

June 1853 The necklace is reworked to make the gem detachable for use as a brooch

1860

1900

20th century onwards The gem is displayed to the public with the rest of the Crown Jewels

Spinel

△ **Octagonal** mixed-cut ruby spinel

Gemstone spinel is a magnesium aluminium oxide, although the name is also given to a group of metal oxides, all of which have the same crystal structure. It is most familiar as a blue, purple, red, or pink gem, but it can occur in other colours; its blood-red variety is sometimes called "ruby spinel". Another variety, star spinels, are so named as they display stars created by natural light reflection within the gem. Most spinel is recovered from stream gravels; the earliest gem dates from 100 BCE and was discovered in a Buddhist tomb.

Specification

Chemical name Magnesium aluminium oxide | **Formula** $MgAl_2O_4$
Colours Red, yellow, orange, red, blue, green, black, colourless
Structure Cubic | **Hardness** 8 | **SG** 3.6 | **RI** 1.71–1.73 | **Lustre** Vitreous | **Streak** White | **Locations** Myanmar, Sri Lanka, Vietnam, Madagascar, Afghanistan, Tajikistan, Pakistan, Australia, Tanzania

Rough

Spinel group | These gem-quality spinels shows the mineral's colour range. Some specimens are water rounded, while others have complete octahedral crystal forms.

Aggregate | This uncut stone is an aggregate of a number of small, gemmy, red spinel crystals that have naturally bonded together.

Magnetite | The distinctive, dark-coloured iron oxide magnetite is one of the spinel group of minerals, seen here as a cluster of black octahedra.

The Black Prince's "ruby"

A case of mistaken identity

The superb spinel known as the Black Prince's Ruby was supposedly given to Edward, the Black Prince, the son of English King Edward III, by Peter the Cruel, king of Castille, after their joint victory at the Battle of Najera in 1367. Another English king, Henry V, wore it and nearly lost it at the Battle of Agincourt in 1415, and it was later set in the British Imperial State Crown. It was thought to be a ruby until the 19th century.

The "ruby" Shown here in its diamond-encrusted mount, the spinel is set with a small natural ruby near the top.

Cut

Fancy cut | This 7.27-carat flawless red spinel is faceted in the shape of a heart, one of the most challenging shapes for a gem-cutter.

Brilliant cut | This fine purple spinel is faceted as a standard brilliant, displaying a total of 52 facets intended to provide a high level of light return.

Round brilliant | Varying the traditional brilliant cut, the cutter has doubled the number of facets on the pavilion of this mauve spinel to increase its brilliance.

Settings

Spinel ring | A large, mixed-cut oval cushion red spinel graces this spectacular ring. The stone is surrounded by brilliant-cut diamonds, with baguette diamonds set into the shanks.

Spinel wonderland | Showcasing the variety of hues found in spinel gems, this gold ring is set with 14 spinels of different colours, cuts, and shapes, to dazzling effect.

Paris Nouvelle Vague bracelet | This dramatic 18-karat gold bracelet by Cartier features spinels, diamonds, pink and yellow sapphires, green garnets, amethysts, emeralds, and fire opals, all set into 252 cups carved from lapis lazuli.

Purple spinel ring | The vivid colour of the brilliant-cut oval purple spinel in this gold ring is emphasized by the contrasting diamonds set on either side of it.

The name **"spinel"** comes from the Latin **spinella,** meaning **"little thorn",** a reference to the **sharp points** of its **crystals**

Catherine II of Russia's "ruby" | c.14th century | Weight: 398.72 carats | Uniform colour and excellent transparency; shown here in a portrait of Catherine the Great, c.1762

Catherine the Great's spinel

△ **Portrait of Tsar Nicholas II on his coronation day**, wearing the Russian Imperial Crown with its spinel

Catherine the Great's "ruby" is the glittering showpiece of the Russian Imperial Crown. It is one of the "Seven Historic Stones", the rarest and most prized items in the royal collection of jewellery that was amassed by Peter the Great. This collection – now known as the Diamond Fund – was enlarged by later tsars, but always belonged to the State.

The "ruby" is actually a 398.72-carat red spinel, the second largest in the world. At the time, spinels were known as "balas rubies", taking their name from a famous mine in present-day Afghanistan. Russian envoy Nikolai Spafary acquired the gemstone in China while conducting trade negotiations with the emperor in 1676. He reportedly paid "a very pretty price" of 2,672 rubles for it.

The spinel already had a colourful history. According to legend, it was found in the 14th century by Chun Li, a Chinese mercenary in Turkic conqueror Timur's army. He found it in the mines of Badakhshan, where he had been exiled after stealing gems in Samarkand. Chun Li tried to present it to the emperor in the hope of winning a pardon, but was murdered by a greedy palace guard who, in turn, was executed when his crime was discovered.

Catherine the Great commissioned the magnificent Imperial Crown for her 1762 coronation. It was fashioned by the court jeweller, Jérémie Pauzié, who removed the spinel from an earlier crown and added other jewels from the royal collection. Worn by Catherine's successors, the crown was concealed from view after the Revolution.

Catherine the Great's spinel

Russian Imperial Crown, displaying the spinel mounted on a central arch, accompanied by 9,936 diamonds and 74 pearls

Emperor Paul I of Russia, Catherine's only son, wearing the crown c.1800

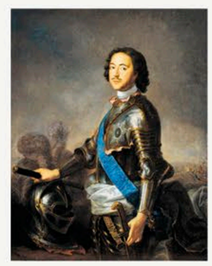
The spinel must have been an exceedingly unlucky stone

Diane **Morgan**
Author

Key dates

1676–1990s

- **1676** The Russian ambassador purchases the "ruby" in China
- **1719** Peter the Great's gem collection forms the nucleus of the Diamond Fund
- **1762** Catherine the Great commissions the Imperial Crown for her coronation
- **1896** The crown features in the coronation of Nicholas II, the last of the Tsars
- **1900** Peter Carl Fabergé makes a miniature replica of the Imperial Crown and Regalia
- **1906** The crown makes its final official appearance at the State Opening of the Duma (legislative assembly)
- **1914** With the outbreak of war, the gem collection is moved to Kremlin vaults
- **1926** The royal jewel collection is rediscovered, and many items are sold off
- **1967** The treasures of the Diamond Fund are exhibited to select high-ranking officials
- **1990s** After the fall of Communism, the crown is placed on display at the Kremlin Armoury Museum



Peter the Great, Tsar of Russia, c.1717

1650 1700 1750 1800 1900 1925 1950 2000

Chrysoberyl

△ **Cat's-eye** chrysoberyl cabochon

Although crystals of chrysoberyl are not uncommon, the gemstone variety alexandrite is one of the rarest and most expensive gems in the world, with specimens seldom exceeding 10 carats. Alexandrite has the extraordinary visual property of appearing green in daylight but red under tungsten light; other forms of chrysoberyl occur in green, greenish yellow, and yellow. Alexandrite was discovered in the Ural Mountains in 1830, and was named after the Russian ruler Alexander II, on whose birthday it was supposedly found.

Specification

Chemical name Beryllium aluminium oxide | **Formula** $BeAl_2O_4$
Colours Green, yellow, brown | **Structure** Orthorhombic
Hardness 8.5 | **SG** 3.7 | **RI** 1.74–1.76 | **Lustre** Vitreous
Streak White | **Locations** Russia, Myanmar, Zimbabwe, Tanzania, Madagascar, USA, Brazil, Sri Lanka

Rough

Gemmy crystals | These large, wedge-shaped crystals are typical of chrysoberyl and are a good colour. They display cyclic twinning (a group of crystals that have formed radially).

Alexandrite crystals | This specimen of alexandrite with mica was mined in Siberia, Russia, which remains a major source of high-quality material.

Twinned crystals | These two crystals growing into a "V" formation from the same point at their base show classic chrysoberyl twinning.

Colours

Cat's-eye chrysoberyl | This semi-transparent oval cabochon, coloured a typical deep yellow known as milk and honey, features a finely formed cat's-eye pattern.

Cat's-eye oval | This oval cabochon of yellow-green cat'seye chrysoberyl has an unusual bluish cast around the area of the "eye", and blemishes on its surface.

Cut

Cat's-eye cabochon | This transparent, cabochon shows not only the distinctive "eye" pattern but also the fibrous inclusions that created it, all in a hazy yellowish hue.

Green brilliant cut | The pale green colour of this stone gives it a luminous shine, emphasized by its unusual 10 main facets, rather than the eight on a standard brilliant.

Settings

Cartier bracelet | This Cartier bracelet features strands of small chrysoberyl beads supporting a 32.93-carat morganite, an 8.16-carat orange sapphire, and four coloured sapphires. It is also set with brilliant-cut diamonds.

Cat's eye cluster ring | This yellow gold ring from around 1900 features an 11.42-carat central stone of cat's-eye chrysoberyl, surrounded by diamonds.

Honey-yellow cat's eyes | The 11 stones set in this cross pendant are honey-yellow; along with greenish yellow, honey-yellow is the most desirable colour of cat's eye.

Arts and Crafts crescent brooch | This silver and gold brooch by Dorrie Nossiter from around 1930 features varied mixed-gem settings of moonstone, peridot, garnet, chrysoberyl, ruby, sapphire, and green zircon.

Vintage brooch | This Victorian brooch is set with a selection of chrysoberyl gemstones in oval cuts. The lines of the metal setting suggest organic forms.

Alexandrite

Changing colours

The alexandrite variety of chrysoberyl displays a colour change, from greenish to reddish, when seen in different light conditions. Alexandrite appears greenish in daylight, where a full spectrum of light is present, but reddish in incandescent light, because it contains less of the green and blue spectrum. The colour change is due to chromium atoms replacing the aluminium in the chrysoberyl structure. This causes intense absorption of light over a narrow range of wavelengths.

Alexandrite in daylight This cushion-cut alexandrite appears to be green when seen in natural daylight.

Alexandrite in incandescent light The same cushion-cut alexandrite takes on a red hue in incandescent light.

Hematite

△ **Oval-cut** hematite

Hematite is an iron oxide and a relatively abundant mineral. Its name comes from the Greek word for "blood" and although it can be various colours, it always produces a red streak. The reddish appearance of Mars is due to the presence of hematite on its surface and is the reason for its nickname, the "red planet". As a gemstone material it is dense with a high refractive index. In powdered form it provides the basis for many paints – pigment made from hematite has been found in cave paintings dating back 40,000 years.

Specification

Chemical name Iron oxide | **Formula** Fe_2O_3 | **Colours** Black, grey, silver, red, brown | **Structure** Trigonal | **Hardness** 5.5–6.5 **SG** 5.1–5.3 | **RI** 2.94–3.22 | **Lustre** Metallic to earthy **Streak** Red to reddish brown | **Locations** China, Australia, Brazil, India, Russia, Ukraine, South Africa, Canada, Venezuela, USA, UK

Group of well-formed hematite crystals | **Rough** | This specimen of hematite has large, well-formed, trigonal crystals of fine cutting material and a bright metallic lustre similar to polished silver.

Specular hematite | **Rough** | Specular hematite is hematite that has formed flattened, bright, and lustrous crystals, as in this example with quartz, from Cumbria, UK.

Hexagonal specimen | **Rough** | This gem-quality hematite is well crystallized and exhibits good hexagonal form, with lustrous metallic faces.

Uncut hematite | **Rough** | This blocky specimen of hematite rough consists of a number of needle-like crystals, and shows a deep red colour.

Hematite frog | **Carved** | Hematite is a popular, inexpensive carving material for objects such as this frog, and has been used in this way since the second millennium BCE.

Taaffeite

△ **Cushion-cut** taaffeite

When a mineralogist or gemologist hears of the discovery of a new and previously unknown gemstone, his or her thoughts go to a seam of rock in a distant mountain range, or the gravels of a stream or river flowing through some exotic jungle. Rarely do their thoughts go to a jeweller's shop in Dublin, Ireland. Yet this is precisely where taaffeite was discovered by Richard Taaffe in 1945 among a number of faceted gems recovered from old jewellery. It is one of the rarest gemstones, and is cut exclusively for collectors.

Specification

Chemical name Beryllium, magnesium, and aluminium oxide **Formula** $BeMg_3Al_8O_{16}$ | **Colours** Pale mauve, green, sapphire blue | **Structure** Hexagonal | **Hardness** 8–8.5 | **SG** 3.60–3.62 | **RI** 1.71–1.73 | **Lustre** Vitreous | **Streak** White **Locations** Sri Lanka, Tanzania, China

Raw gem | **Rough** | This water-rounded crystal of taaffeite rough has a "window" polished into one end so the cutter can assess its clarity.

Lavender colour | **Colour variety** | The pale, almost transparent, mauve colour for which the gemstone is best known is displayed in this brilliant-cut oval cushion specimen.

Pentagonal taaffeite | **Cut** | This 8.5-carat taaffeite is exceptionally large and is faceted in a pentagonal step-cut with a rich plum colour.

Taaffeite is the only gemstone in history to have been identified from a stone that had already been faceted

Cut taaffeite gemstone | **Cut** | Even a relatively simple brilliant cut has extra sparkle and "fire" due to the taaffeite's double refraction, as seen here.

Extraordinary colour | **Colour variety** | This 1.23-carat oval stone has a highly unusual bright purplish-red colour and features a brilliant-cut crown.

Cassiterite

△ **Cassiterite rough**, also known as tin oxide

Cassiterite, a major source of tin, takes its name from *kassiteros*, the Greek word for the element. The vast majority of cassiterite is opaque black or brown, but occasionally transparent, reddish-brown crystals are found and can be faceted for collectors. Facet-grade crystals are sometimes recovered from rock, but most gemstone material is collected from stream gravels where it has weathered from the rocks in which it formed. Cassiterite continues to be mined for tin, especially in Malaysia, Thailand, Indonesia, and Bolivia.

Specification

Chemical name Tin oxide | **Formula** SnO_2 | **Colours** Medium to dark brown | **Structure** Tetragonal | **Hardness** 6–7 | **SG** 6.7–7.1 | **RI** 2.0–2.1 | **Lustre** Adamantine to metallic | **Streak** White, greyish, brownish | **Locations** Portugal, Italy, France, Czech Republic, Brazil, Myanmar

Cassiterite in matrix | **Rough** | Here, finely formed cassiterite crystals rest on a groundmass of muscovite. Their shiny lustre is adamantine (diamond-like).

Gemmy crystals | **Rough** | Transparent, reddish-brown, gem-quality crystals of cassiterite rest on this groundmass of massive cassiterite.

Cassiterite crystals | **Rough** | This cluster of sharp, well-defined, dark crystals with excellent lustre grow outwards from a lump of massive cassiterite.

Tin from cassiterite

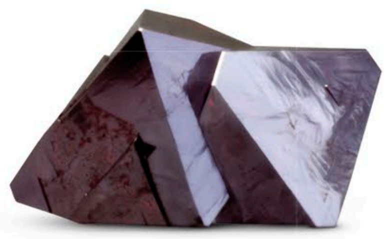
Bronze Age to baked beans

Cassiterite-sourced tin has been traded across the Mediterranean world since the Bronze Age began in about 3000 BCE. Tin is the essential component (along with copper) of bronze, and the dark colour of cassiterite makes it easy to see against the granite in which it typically forms. In modern times, the plating of steel with non-toxic and corrosion-resistant tin has revolutionized food storage with the creation of the tin can, often just called a "tin".

Tin cans Tin derived from cassiterite has been essential in the long-term preservation of food.

Faceted oval | **Colour variety** | This brilliant-cut oval shows the yellow-brown colour typical of most faceted cassiterites. Its colour flickers in the light like a diamond.

Faceted round | **Colour variety** | Here, the dark inclusions contrast with the colourless cassiterite, an unusual colour considered rare enough to facet into a cut gemstone.



△ **Cuprite rough**, an uncommon copper mineral

Cuprite

The mineral cuprite is named from the Latin *cuprum*, meaning "copper", and it is sometimes known as ruby copper due to its distinctive carmine-red colour. Almost every faceted stone larger than one carat has come from a single deposit in Namibia, which is now exhausted – and even these are rare. Faceted stones are too soft to wear, but their brilliance and garnet-red colour is exceptional, making them highly desirable as collector's stones. Other localities that produce lesser amounts of smaller gem material are Australia, Bolivia, and Chile.

Specification

Chemical name Copper oxide | **Formula** Cu_2O | **Colours** Shades of red to nearly black | **Structure** Cubic | **Hardness** 3.5–4 | **SG** 6.1 | **RI** 2.85 | **Lustre** Adamantine, submetallic **Streak** Brownish red | **Locations** Namibia originally; now also Australia, Bolivia, Chile

Small cuprite crystals | **Rough** | This group of tiny cuprite crystals provides much gem-quality material – the faces shine with adamantine lustre.

Gem-quality crystals | **Rough** | These crisply formed cuprite crystals have good transparency, and each would cut a small, but fine, gem.

Rectangular step | **Cut** | The superb clarity of this rare cuprite gem is emphasized by using a shallow step cut. It has intense colour and a shiny lustre.

Oval brilliant | **Cut** | This cuprite gem has developed a slight metallic sheen on its surface, most likely as the result of a reaction with light over time.

Common cuprite | **Rough** | This cuprite specimen has a large number of minute crystals, and exhibits a rare form of fibrous cuprite, chalcotrichite.

Patiala necklace | 962.25 carats total (diamonds) | Diamonds, rubies, platinum

△ **Patiala necklace** in its restored state

Maharaja's **Patiala necklace**

The Patiala necklace was a spectacular, five-tiered Art-Deco diamond necklace, which incorporated the famous De Beers diamond and was made for India's Maharaja of Patiala, Bhupinder Singh, by Cartier in 1928. It later disappeared for a time, but was rediscovered and restored.

Watch with a portrait of Bhupinder Singh, c.1930

The necklace's platinum base contained 2,930 diamonds, weighing a collective 962.25 carats. The world's seventh-largest diamond, the light yellow "De Beers", formed its centrepiece at 234.65 carats. Other highlights included two Burmese rubies and an 18-carat tobacco-coloured diamond, one of the necklace's seven large diamonds ranging from 18 to 73 carats.

Yadavindra Singh inherited the necklace with his father's title in 1938. However, the Indian state came under financial pressure and was forced to sell off several of the necklace's stones. Its platinum base later vanished from the royal treasury – presumably also sold – after India achieved independence in 1947. In 1998, the greatly diminished necklace resurfaced in a London antiques shop, where a Cartier representative recognized and purchased it. The largest of its stones were missing, including the famous De Beers diamond.

Cartier set about restoring the necklace, initially replacing missing diamonds with other natural stones such as white and yellow sapphires, white topaz, and garnets. However, these lacked the same brilliant effect as diamonds. The jewellers opted for a dazzling array of white cubic zirconias and other synthetic diamonds, as well as synthetic topaz, ruby, smoky quartz, and citrine stones.

In 2002, Cartier displayed the necklace in its New York boutique, attracting crowds of onlookers. Even without all of its original huge and valuable gems, the necklace was still a dazzling sight.

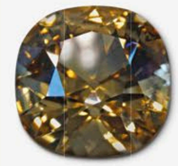
Key dates

1888–present

1880

1888 The De Beers diamond is discovered in a South African De Beers mine

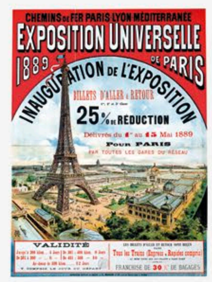
1889 The diamond is cut and displayed in Paris at the Exposition Universelle. Rajendra Singh, Maharaja of Patiala, purchases it



The De Beers diamond

1900

1925 Bhupinder Singh visits Cartier in Paris with the De Beers diamond and numerous other unset stones to commission a necklace – Cartier's largest ever commission



Poster for the Exposition Universelle of 1889

1920

1928 Cartier completes the necklace and exhibits it before it is sent to India

1940

1947 The necklace disappears after several stones, including the De Beers, are sold separately

1960

1980

1982 The De Beers diamond reappears at auction by Sotheby's in Geneva, where it sells for below the asking price

1998 Eric Nussbaum, a Swiss born gemologist working with Cartier, discovers the necklace in a London antique shop

2000

2002–present Cartier exhibits the restored necklace internationally

2015

> A wonder of **natural beauty** and **supreme craftsmanship**
>
> Richard **Dorment**
> Art critic

Bhupinder Singh's silver-gilt dinner service, made for a visit by future king Edward VIII in 1922

Turban ornament
This gold and silver ornament from around 1900 is set with emeralds, diamonds, and pearls.

Earring (one of a pair)
Van Cleef & Arpels made this earring with brilliant-cut diamonds and step-cut sapphires in 1935.

Nose ring
This piece from 1925–50 consists of gold set with diamonds, seed pearls, and rubies.


Pendant brooch
Made of platinum, this Van Cleef & Arpels brooch from 1924 is set with pearls, diamonds, rubies, sapphires, and emeralds.

Clip Feuille Persane
This 1966 Persian leaf clip by Van Cleef & Arpels is made of gold and set with rubies and diamonds.

Turban ornament
Called a *jigha*, this 18th-century gold, elephant-shaped ornament is set with rubies, diamonds, and emeralds.

Brooch
This jade brooch from c.1650–1750, inlaid with rubies, emeralds, and diamonds, was remade by Cartier c.1930.

Forehead ornament
This gold piece, c.1900, is called a *tika* and is set with emeralds and diamonds, with attached pearls.



Peacock brooch
This gold brooch from c.1905 is set with diamonds and enamelled for colour.

Turban jewel
Made of platinum and set with sapphire and diamonds in c.1920, this jewel was modified c.1925–35.

Indian jewels

Sapphires, rubies, garnets – India has been famed for centuries as a source of some of the world's most precious gemstones, a treasure trove matched by the skills of its goldsmiths and jewellers. Cultural traditions and techniques flowing from India to Europe and the USA and back have enhanced the jewellery of both East and West. Many of the pieces here come from the vast collection of Sheikh Hamad bin Abdullah Al Thani, which holds some of the world's rarest Indian jewels.

Rutile

△ **Cabochon** of rutile needles in quartz

Arguably, rutile is more important as a mineral that imparts desirable characteristics to other stones than it is as a gem in its own right. Rutile commonly forms microscopic, oriented inclusions in other minerals, and produces the asterism shown by star rubies and sapphires. It is also familiar as the golden, needle-like crystals trapped inside crystals of rutilated quartz, a material that has been used as an ornament since ancient times. Some reddish rutile crystals are darkly transparent and these are sometimes faceted for collectors.

Specification

Chemical name Titanium dioxide | **Formula** TiO_2 | **Colours** Reddish brown to red, golden | **Structure** Tetragonal | **Hardness** 6–6.5 | **SG** 4.2–4.3 | **RI** 2.62–2.90 | **Lustre** Sub-adamantine to sub-metallic | **Streak** Pale brown to yellowish | **Locations** Sweden, Italy, France, Austria, Brazil, USA

Quartz crystal with rutile | **Rough** | This example of natural, clear quartz crystal is shot through in all directions with multiple acicular (needle-like) crystals of rutile.

Golden rutile | **Colour variety** | Rutile often takes on a bright golden colour when enclosed in quartz, as can be seen in this example with sheaf-like needles.

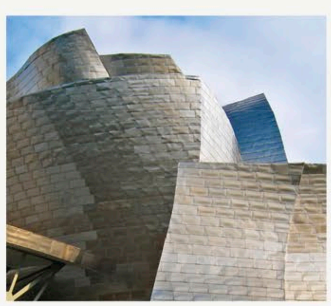
Cabochon | **Cut** | This polished quartz cabochon shows a large number of inclusions of rutile needles forming a dense pattern beneath its surface.

Scent bottle | **Carved** | This carved scent bottle is made from rutilated quartz, with fine golden rutile needles throughout. It is also adorned with gold and onyx.

Titanium from rutile

Everyday uses

Although it may not be a household name, rutile is a vital part of modern life. Titanium is derived from rutile and, because it does not react with organic tissues, it is used to make artificial joints for hip and knee replacements and other prosthetic devices. It is also extensively used in aircraft and other applications that require high strength, low density, and excellent corrosion resistance. Titanium dioxide, meanwhile, is the main white pigment in paint, plastics, and white enamel.



Guggenheim Museum Architect Frank Gehry used titanium as the surface for his curving building in Bilbao, Spain.

Reverse intaglio | **Carved** | Rutile needles are visible in the stopper of this scent bottle. The body is carved from crystal quartz with a reverse intaglio carving.

Diaspore

△ **Emerald-cut** diaspore gemstone

While its scientific name comes from the Greek word *diaspora*, meaning "scattering", and refers to the way diaspore crackles under high heat, this gem was marketed under the trade name Zultanite, which is more suggestive of its pleochroic (colour-changing) beauty (the name was later replaced by Czarite). Diaspore displays light green tints in sunlight and raspberry purplish pinks in candlelight, and it gleams a champagne colour under indoor lighting. In mixed lighting, variations on all of these colours can occur.

Specification

Chemical name Hydrous aluminium oxide | **Formula** AlO(OH) | **Colours** White, yellow, lilac, pink | **Structure** Orthorhombic | **Hardness** 6.5–7 | **SG** 3.3–3.4 | **RI** 1.70–1.75 | **Lustre** Vitreous | **Streak** White | **Locations** Turkey, Russia, USA

Diaspore crystals | **Rough** | In this specimen, a number of purplish diaspore crystals rest on a groundmass of emery – a granular form of corundum.

Gemmy crystal | **Rough** | This almost colourless, gemmy crystal of diaspore contains a number of striations parallel to the stone's long faces.

Crystal of diaspore | **Rough** | The material comprising this facet-grade gem crystal of diaspore exhibits some transparency, but this is barely visible beneath the many characteristic striations that have developed on its surface.

Zultanite gem | **Colour variety** | Cut in a square cushion, this superb natural gem shows typical colouring, with flashes of green, blue, red, and other hues.

Fine gem | **Cut** | The clarity and brilliance that diaspore gems can achieve are illustrated by the stunning facets and light refraction in this square, scissors-cut stone.

Brilliant-cut gem | **Cut** | This skilfully faceted diaspore gemstone features an oval, modified brilliant cut with an unusually large number of faces.

Diaspore was first described in 1801 after it was found in the Ural mountains of Russia

Fluorite

△ **Finely crystallized**, multiple grouping of interpenetrating green fluorite cubes

Representing one of the widest colour ranges of any mineral, fluorite's hues tend to be vibrant, with violet, green, and yellow the most common. Its colours are commonly found as zones of different colours within a single crystal, and these zones typically follow the contour of the crystal faces. Fluorite is easily cleaved (broken along its atomic planes) and so is faceted for collectors only. For this, the stone is carefully oriented to avoid its four cleavage planes, and then cut and polished slowly to avoid heat or vibration.

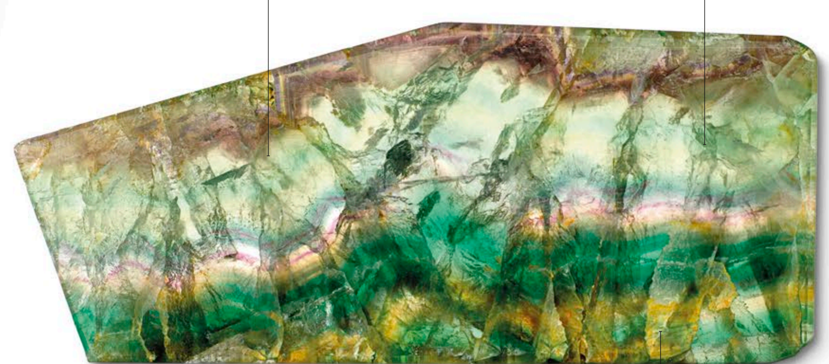
Specification

Chemical name Calcium fluoride | **Formula** CaF_2
Colours Colourless, blue, green, purple, orange | **Structure** Cubic
Hardness 4 | **SG** 3.0–3.3 | **RI** 1.43–1.44 | **Lustre** Vitreous
Streak White | **Locations** Canada, USA, Mexico, South Africa, China, Mongolia, Thailand, Peru, Europe, UK

Rough

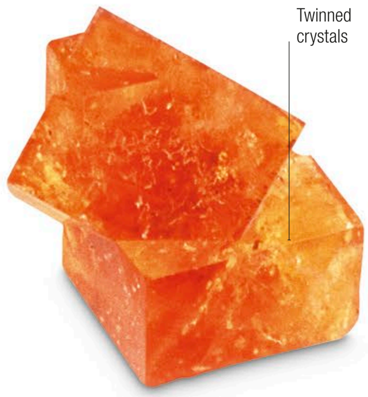
Fluorite cubes | A group of purple fluorite cubes cap a block of massive white fluorite. The purple cubes in this specimen are capped with partially dissolved brown calcite.

Blue John | This uncut piece of Blue John shows the layering of purple and yellow colours characteristic of this fluorite variety (see box, opposite).



Fluorite slice | This thin, semi-transparent, slice of fluorite, around 5mm (¼in) in thickness, displays a variety of colours, as well as visible layering.

Colour



Interpenetrating crystals | These three striking orange fluorite crystals show a cubic structure, and demonstrate a typical pattern of twinning for this type of mineral.

Fluorescent fluorite | The majority of fluorite fluoresces under ultraviolet light, as here, the colour of the fluorescence depending on the trace elements present.

Opalescent Art Deco glass by René Lalique and Louis Tiffany was produced using fluorite in the glass blend

Cut

Cushion cut | The multi-faceted, round-cornered cut brings out the intense, deep green colouring of this large, 9.24-carat fluorite gemstone, found in the UK.

Brilliant cut | This brilliant cut demonstrates a high level of skill on the part of the faceter: multiple facet reflections are visible coming from the bottom half of the stone.

Cushion cut | The superbly executed cut of this oval, cushion-cut fluorite emphasizes reflections and hints of blue. Blue is a common colour in fluorite.

Settings

Fluorite bead necklace | This necklace is composed of numerous circular, bi-convex beads of green and purple fluorite, many showing typical colour layering. Although fluorite is rarely used in jewellery as it fractures easily, it can be worn as beads.

Fluorite carvings

Use of massive fluorite

Fluorite with a massive habit – numerous intergrown crystals, rather than single ones – has been carved since ancient times. The ancient Egyptians used it for statues and scarabs, and Chinese artisans have carved fluorite for more than 300 years, recently making "New Age" items such as spheres and obelisks. Blue John, a massive English fluorite with layers of yellow and purple, has been carved since Roman times.

Fluorite bowl The craftsmanship of this finely carved, layered bowl is evident in the thinness of its walls.

△ **Calcite crystals** displaying a vivid purple colouring

Calcite

Although calcite forms spectacular crystals of varied shapes and in virtually all colours, most calcite occurs in the form of limestone, marble, or travertine, all of which are used as ornamental and carving stones. Travertine is a dense, banded rock formed by the evaporation of river and spring waters, depositing coloured layers of calcite. Sliced travertine and marble were used extensively as a facing stone for buildings in ancient Greece and Rome, and many ancient Egyptian "alabaster" carvings are actually calcite.

Specification

Chemical name Calcium carbonate | **Formula** $CaCO_3$ | **Colours** Colourless, white, various | **Structure** Trigonal | **Hardness** 3 | **SG** 2.7 | **RI** 1.48–1.66 | **Lustre** Vitreous | **Streak** White | **Locations** Iceland, USA, Germany, Czech Republic, Mexico

Calcite and apatite | **Rough** | Calcite commonly occurs with other gemstones, usually providing a later infilling, as with these apatite crystals.

Stunning crystals | **Rough** | Calcite has the largest number of different crystal structures of any mineral, including these perfectly formed scalenohedrons.

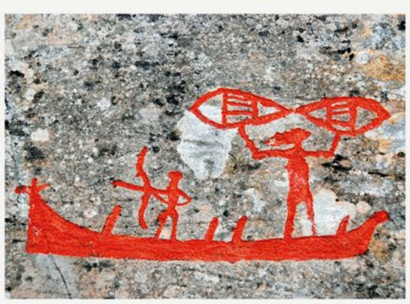
Scalenohedron | **Rough** | Scalenohedrons, a form of calcite, are essentially high-angle, hexagonal pyramids, as seen in this single, well-defined example.

Faceted stone | **Cut** | This superb stone from Tanzania was faceted by a master cutter. Calcite is remarkably difficult to facet because it is soft and breaks easily.

The Viking sunstone

Crystal compass

Seafaring Vikings relied on the sun for navigation, but cloudy days posed a problem. Norse sagas talk of a "sunstone" that could help find its position on any day, grey or bright. Some scientists think this may have been calcite: a calcite crystal polarizes light into two beams, which can be lined up to find the location of the sun. Modern calcite "detectors" achieve this within 1 per cent accuracy.



Viking hunters This rock painting at Alta in Norway depicts two Vikings fishing – one casts a net. They may have been guided by a sunstone.

Calcite alabaster | **Carved** | Ancient Egyptians used calcite for items such as this canopic stopper from Tutankhamun's tomb.

△ **Crystals of aragonite** in a rock groundmass

Aragonite

Aragonite occurs in rocks in the same way as other minerals, but it is also produced by certain biological processes – the shells of many marine molluscs, as well as corals and pearls, are composed mainly of aragonite. Like all carbonates, it is soft, fragile, and very difficult to facet, with transparent crystals only rarely faceted for collectors. Facet-quality crystals come from the Czech Republic, and there are superb cave formations in Mexico, but its type locality is Molina de Aragón in Spain after which it is named, following its discovery there in 1797.

Specification

Chemical name Calcium carbonate | **Formula** $CaCO_3$
Colours Colourless, white, grey, yellowish, reddish, green
Structure Orthorhombic | **Hardness** 3.5–4 | **SG** 2.9
RI 1.53 – 1.68 | **Lustre** Vitreous inclining to resinous
Streak White | **Locations** Spain, Italy, China

Spanish aragonite | **Rough** | The purple aragonite from the classic Spanish locality forms pseudo-hexagonal prisms, a cluster of which is shown here.

Aragonite sputnik | **Rough** | Mineral collectors sometimes refer to these radiating groups of orange pseudo-hexagonal aragonite crystals as "sputniks" or star clusters. The clusters are formed from multiple twin crystals.

Flos Ferri | **Rough** | Aragonite sometimes forms in tree-like crystal groups. Known as Flos Ferri, or "popcorn" aragonite, it is brittle and extremely fragile.

Aragonite slice | **Cut** | Layered aragonite forms in caves as stalactites. It is polished as cabochons, used as jewellery mounting or, if large enough, as wall panelling.

Orange aragonite | **Colour variety** | This naturally smoothed aragonite pebble displays a particularly bright orange colouring and faint pale layering.

Turquoise cabochon | **Cut** | Aragonite layered and banded together in mixed colours is sometimes cut *en cabochon*, as seen in this turquoise, pear-shaped stone.

Monkey ornament | **Carved** | Aragonite is soft and easily carved, so when it is compact enough, ornaments such as this brown monkey can be produced.

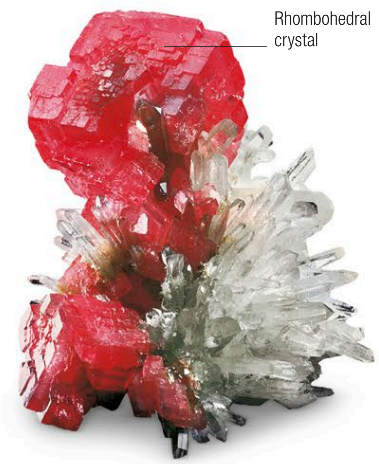
Rhodochrosite

△ **Fine-quality, transparent** brilliant-cut rhodochrosite

Rhodochrosite's classic colour is rose-pink. It occurs both as transparent crystals and banded stalactitic rock, and is soft and very fragile; faceted clear crystals are rare and sought after. Vibrant, facet-quality, cherry-red crystals are found in Colorado, USA, and at Hotazel in South Africa. Banded "Inca rose" rhodochrosite comes from Argentina: this is the main source of banded material, which is cut *en cabochon*, into beads, and used in carvings. Concentrically banded slices of rhodochrosite stalactites are polished and mounted in silver as pendants.

Specification

Chemical name Manganese carbonate | **Formula** $MnCO_3$
Colours Rose-pink, cherry red | **Structure** Hexagonal or trigonal
Hardness 3.5–4 | **SG** 3.6 | **RI** 1.6–1.8 **Lustre** Vitreous to pearly | **Streak** White | **Locations** USA, South Africa, Romania, Gabon, Mexico, Russia, Japan



Rhodochrosite on quartz | **Rough** | In this magnificent specimen, facet-grade rhombohedral crystals of rhodochrosite rest on a group of quartz crystals.

"Inca rose" | **Cut** | The distinctive swirls and patterns of this slice of massive rhodochrosite are characteristic of the Argentinian variety called "Inca rose".

Brilliant oval | **Cut** | One of the most difficult gems to facet because of its softness, this brilliant oval has been cut by a highly skilled lapidary.

Cabochon | **Cut** | The swirls and layering typical of massive rhodochrosite are clearly seen in this irregular-shaped rhodochrosite cabochon.

Necklace | **Set** | Created by Tony Duquette (1914–99), this glorious necklace contains pearl, amber, rose quartz, amethyst, garnet, and a large rhodochrosite.

Rhodochrosite bowl | **Carved** | The lapidary has shaped this bowl to emphasize the superb natural pattern of the soft and easy to carve rhodochrosite.

Rhodochrosite parrot | **Carved** | Made by a master lapidary in Idar-Oberstein, Germany, in the late 20th century this parrot has a black agate beak, and stands on a base of quartz.

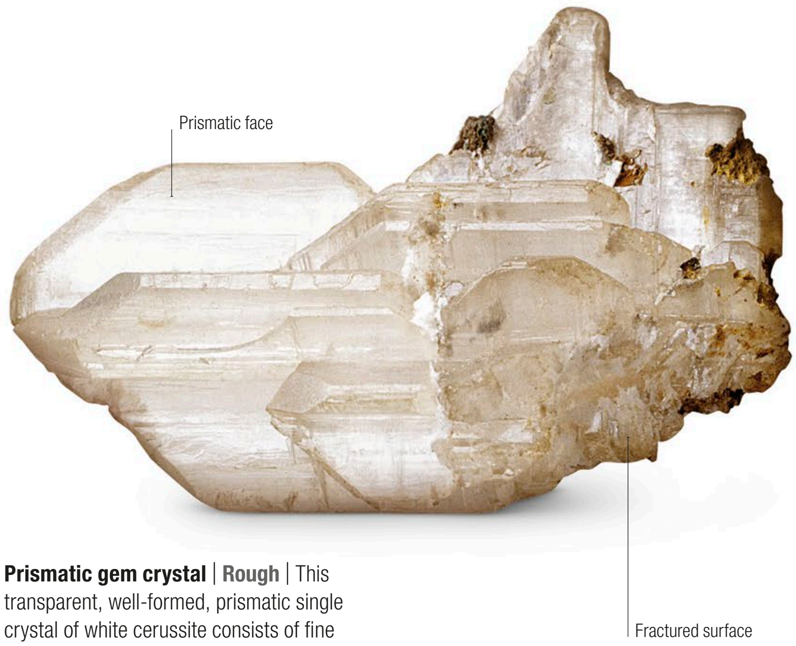
Cerussite

△ **Group of cerussite crystals** from Cumbria, UK

Cerussite has been known since antiquity and is named after the Latin *cerussa*, or white lead pigment. A lead carbonate, cerussite is the most common ore of lead after galena. It is generally colourless, but may be blue to green when copper impurities are present. Its refractive index is nearly as high as that of diamond, making its faceted stones especially brilliant. Unfortunately, such stones are rare; difficult to facet due to the gem's softness, brittleness, and tendency to break, they are also too soft to be worn.

Specification

Chemical name Lead carbonate | **Formula** $PbCO_3$
Colours White, blue to green | **Structure** Orthorhombic
Hardness 3–3.5 | **SG** 6.5 | **RI** 1.8–2.1 | **Lustre** Adamantine to vitreous | **Streak** Colourless | **Locations** Namibia, Morocco, Australia, USA



Prismatic gem crystal | **Rough** | This transparent, well-formed, prismatic single crystal of white cerussite consists of fine gem-quality material.

Cumbrian crystals | **Rough** | The county of Cumbria, in northern England, has produced cerussite since Roman times. This group of crystals is a fine example.

Twinned crystals | **Rough** | Cerussite is one of only a few minerals that produces star or cross-shaped twin crystals, such as in this excellent specimen.

Unusually long crystals of cerussite were found in the Pentire Glaze mine in Cornwall, UK

Faceted cerussite | **Cut** | Similar to rhodochrosite, cerussite is soft and extremely difficult to facet. Gems like this brilliant are rare and cut only for collectors.

Cerussite in cosmetics

The deadly beauty product

From around the 16th century, cerussite was widely used in cosmetic products designed to lighten the skin – a popular variety was known as "Venetian ceruse". However, due to the the mineral's lead content, such beauty treatments were also poisonous to the user. Symptoms included swelling of the eyes, changes to skin texture, and hair loss – perhaps related to this, by the 18th century it had become fashionable to shave the top of the hairline. In severe cases, lead poisoning could cause death.

Elizabeth I The English queen was rumoured to be a user of the "Venetian ceruse" cosmetic.

BYZANTINE JEWELS

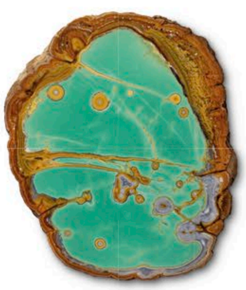
Just like the Romans had done before them, the people of the Byzantine empire wore jewellery for decoration and to indicate status, and gave it as diplomatic gifts. Between the 4th and 15th centuries, the huge wealth of the empire and its expanded trading network meant that Byzantine jewellers had unprecedented access to vast quantities of gold and a variety of gemstones, especially pearls and garnets. As a consequence, the Byzantine era is noted for its abundance of lavish jewellery.

Byzantine jewellery often featured polished cabochons prominently set in gold. Showy, colourful pieces were the most popular, and rings, bracelets, and necklaces often featured stones in alternating colours. The empire's extensive gold mines supplied the jewellers, and the metal was intricately worked into detailed open patterns known as *opus interrasile*, always with the intention of showing off the brightly-coloured stones. Religion played an important role in jewellery design: crucifix neck pendants, earrings, and rings engraved with images of Christ, angels, and the saints were thought to provide spiritual protection and express devotion, as well as displaying the wearer's wealth.

[They wore] collars of gold and translucent necklaces of sparkling gems and precious pearls

Niketas **Choniates**
Greek Byzantine civil servant

Empress Theodora, Byzantine mosaic, San Vitale, Ravenna, c.6th century
This mosaic depicts the Empress and her attendants adorned with gems. She wears a diadem studded with sapphires, emeralds, and red stones, strands of pearls, and a square pendant set with emeralds, pearls, and sapphires.



Variscite

△ **Sawn variscite** nodule showing its internal pattern

Found as fine-grained masses, in veins, crusts, or in nodules, and occasionally as crystals, variscite is valued as a semiprecious gemstone for cabochons, carvings, and as an ornamental material. Black webbing sometimes occurs in the matrix of the variscite local to Nevada, USA, and this form of the mineral is often confused with green turquoise; cabochons originating in Nevada that look like turquoise but are in fact variscite may be sold as "variquoise". Variscite is porous and can discolour if worn next to the skin.

Specification

Chemical name Aluminium phosphate | **Formula** $AlPO_4.2H_2O$ **Colours** Pale to apple-green | **Structure** Orthorhombic **Hardness** 3.5–4.5 | **SG** 2.5–2.6 | **RI** 1.55–1.59 | **Lustre** Vitreous to waxy | **Streak** White | **Locations** Austria, Czech Republic, Australia, Venezuela, USA, especially Utah

Crystalline variscite | **Rough** | In this specimen, a crust of crystalline variscite has formed on top of a large piece of massive (lacking a definite shape) variscite.

Raw gem | **Rough** | An end of this piece of variscite gem rough has been polished to reveal its colour and solidity. It has a waxy, semi-matte lustre.

Tumbled variscite | **Cut** | Variscite unsuitable for cabochons is often tumble-polished to disclose interesting swirls and patterns, and sold for ornamental use.

Variscite is named for Variscia, the old name for the German district of Voightland, where it was first discovered in 1837

Oval cabochon | **Cut** | Variscite with a consistent colour and density can be cut into attractive cabochons like this one, which has been polished to reveal its vitreous lustre.

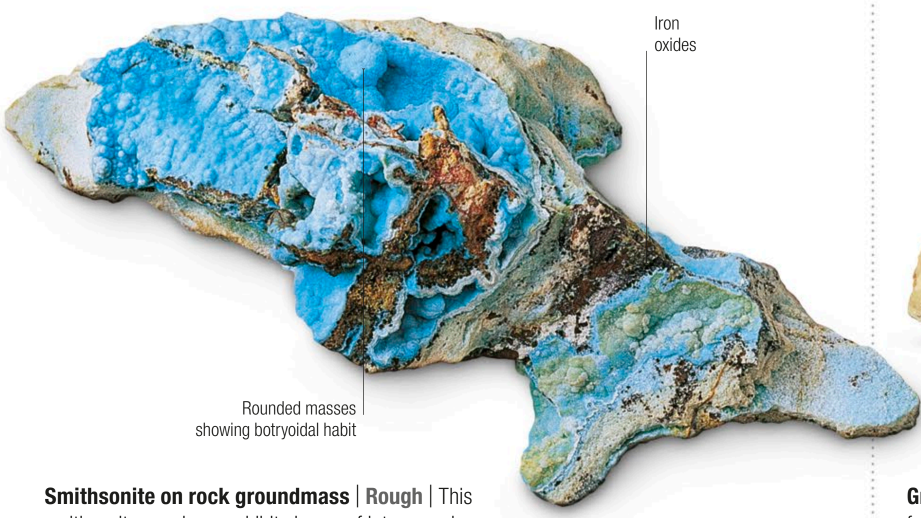
Smithsonite

△ **Rectangular cabochon** of smithsonite

Smithsonite can be various colours including yellow and pink, but blue-green is the most prized of all. Crystals are found occasionally – spectacular examples come from Tsumeb, Namibia – and sometimes faceted for collectors. Most gemstone material is cut *en cabochon* or carved into ornaments, but it is too soft for general wear as jewellery. Aside from its use as a gem, it is mined as a major source of zinc; it is thought that it may have provided the zinc component of brass in ancient metallurgy. One of the main sources is the Kelly Mine, New Mexico, USA.

Specification

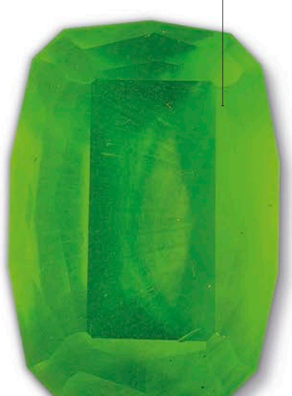
Chemical name Zinc carbonate | **Formula** $ZnCO_3$ | **Colours** White, blue, green, yellow, brown, pink, lilac, colourless | **Structure** Hexagonal | **Hardness** 4–4.5 | **SG** 4.3–4.5 | **RI** 1.62–1.85 | **Lustre** Vitreous to pearly | **Streak** White | **Locations** Namibia, Zambia, Australia, Mexico, Germany, Italy, USA



Smithsonite on rock groundmass | **Rough** | This smithsonite specimen exhibits layers of intense colour set in a groundmass of iron oxides. Its botryoidal habit (like bunches of grapes) is visible.

Greek specimen | **Rough** | This smithsonite from Avron, Attica, Greece, shows one a yellow hue rather than the more commonly seen blue green shades.

Cabochon | **Cut** | Smithsonite is brittle, soft, and easily abraded or chipped, as at the base of this example, but this cabochon is desirable for its intense blue colour.



Kelly specimen | **Cut** | This rare, faceted smithsonite, is an example of the superb-quality material that came from the Kelly Mine, New Mexico, USA.

Oval cabochon | **Cut** | The solid translucent material of this oval cabochon brings out the blue-green hue, the colour traditionally associated with smithsonite.

Changing names

Calamine to Smithson

Smithsonite was originally called by the umbrella name calamine – as in the anti-itch lotion used to treat skin problems, which contains the powdered mineral. The English chemist and mineralogist John Smithson discovered that calamine was in fact three different minerals, and smithsonite was named in his honour in 1832. The other two minerals were called hemimorphite and hydrozincite. Smithson also made the bequest that led to the establishment of the Smithsonian Institution.

James Smithson (1765–1829)
Smithsonite is named after Smithson, the mineralogist who discovered it.

Azurite

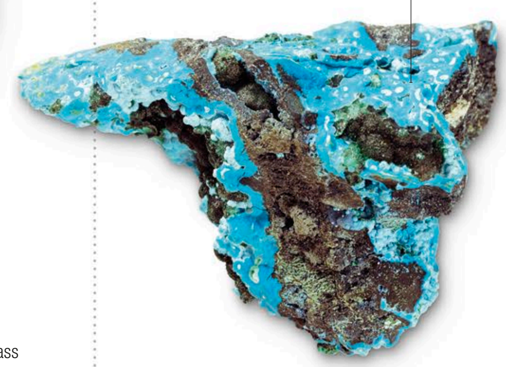
△ **Sphere** of radiating azurite crystals

Azurite is thought to have been used in blue glaze in ancient Egypt, and it was used as a blue pigment in Renaissance European art. It takes its name from the Persian *lazhuward*, meaning "blue". Azurite is cut *en cabochon* and, in rare cases, is faceted for collectors. Spheres of radiating azurite crystals more than 2.5cm (1in) in diameter are sometimes worn as jewellery, and slices of these are mounted in silver frames as pendants. Banded azurite and malachite used for ornamental purposes is called chessylite, after Chessy, France, where it was found.

Specification

Chemical name Copper carbonate | **Formula** $Cu_3(CO_3)_2(OH)_2$ **Colours** Azure to dark blue | **Structure** Monoclinic | **Hardness** 3.5–4 | **SG** 3.7–3.9 | **RI** 1.72–1.85 | **Lustre** Vitreous to dull to earthy | **Streak** Blue | **Locations** France, Mexico, Australia, Chile, Russia, Morocco, Namibia, China

Large crystals | **Rough** | This stunning mixed specimen features a cluster of unusually large and finely crystallized azurites that have developed on a groundmass of goethite, a form of iron hydroxide.



Mixed minerals | **Rough** | Azurite often occurs with other copper minerals, as in this specimen of azurite and chrysocolla in a rock groundmass.

Australian azurite | **Rough** | Australia is a mineral-rich country, with various locations yielding azurite sources as well as extensive copper deposits.

Blue pigment

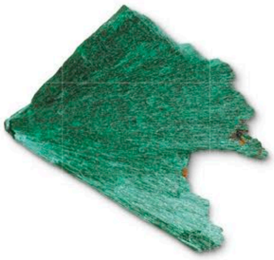
An alternative source of colour

Renaissance painters conventionally used lapis lazuli as a blue pigment. However, it was expensive, and azurite made a cheap and plentiful alternative. Unfortunately, powdered azurite is unstable in open air: moisture causes a replacement of some of the carbon dioxide in azurite with water, converting it to green malachite. This is why some of the blue in old paintings has turned green over time, including Giotto's fresco cycle in Padua, Italy, dating back to the early 14th century.

Giotto's Lamentation of Christ
Patches of azurite have deteriorated from their original blue colour.

Azurite heart | **Cut** | Azurite and malachite are commonly intermixed, and can make spectacular cabochons, as in this carved, heart-shaped stone.

Mixed cabochon | **Cut** | When cut in the proper direction, the patterns produced by mixtures of malachite and azurite can be spectacular, as demonstrated here.



Malachite

△ **Piece** of fibrous malachite

Malachite powder was used as eyeshadow, pigment for wall painting, and in glazes and coloured glass in ancient Egypt around 5,000 years ago. It was also a major source of copper, as it still is. The ancient Greeks used it in children's amulets, the Romans to ward off the evil eye, and the Chinese to decorate vases. In the 19th century, huge quantities were mined in the Ural Mountains, Russia, and an entire cathedral was decorated with it. Today, it is an important gemstone and ornamental mineral, used in cabochons, polished slabs, and carvings.

Specification

Chemical name Copper carbonate | **Formula** $Cu_2CO_3(OH)_2$
Colours Bright green | **Structure** Monoclinic | **Hardness** 3.5–4 | **SG** 3.2–4.1 | **RI** 1.65–1.91 | **Lustre** Adamantine to silky | **Streak** Pale green | **Locations** DR Congo, Australia, Morocco, USA, France

Gem malachite | **Rough** | When sliced across the "bubbles", this malachite rough will produce fantastic "bulls-eye" patterns, as in this example.

Peruvian malachite | **Rough** | This example from the Atacama desert of Peru features malachite crystals that have developed on a bed of atacamite.

Stalactitic habit of malachite | **Rough** | It is reasonably common for malachite to occur in stalactitic form, sometimes giving rise to irregular shapes such as this.

> **… a field of ripe cabbages with their prevailing hue of malachite green…**
>
> Walt **Whitman**
> Author

Spectacular patterns | **Cut** | When sliced across the "bubbly" structure of malachite, a stunning pattern is revealed, as shown in this polished slice.

Malachite pendant | **Set** | This polished piece of malachite is cut to show a cross section of its layers in a sweeping, linear arrangement, in contrast to the popular "bubble"-style patterns. It is set in an unusual pendant with silver and diamonds.

Portrait of Queen Desideria of Sweden and Norway, 19th century | Owner of the malachite parure

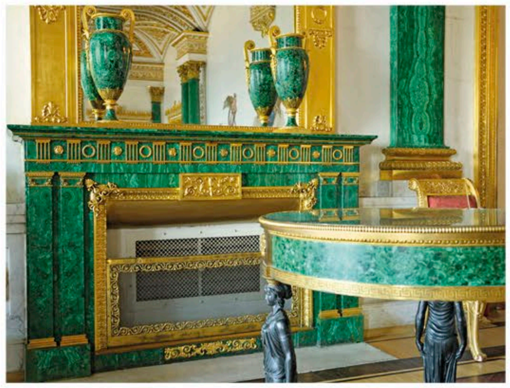
△ **One of the malachite stones** featuring carvings of classical scenes

Queen Desideria's malachite parure

Unlike many treasures held by Europe's royal families, the 19th-century parure owned by Queen Desideria of Sweden and Norway is made from something quite common – an inexpensive green stone called malachite.

Despite its lowly status as a gemstone, malachite became the height of fashion in the early 1800s, due in part to the era's obsession with new geological discoveries. It was often set into jewellery, and was even used to inlay entire rooms. Malachite is not transparent and is not cut into facets like diamonds; rather, it is formed into smooth cabochons or carved into detailed shapes.

Queen Desideria's parure is something of a mystery. Although it appears on an official list of the queen's jewels, there is no record of her wearing it. There are some clues, however, as to its origin. The back of the tiara bears the initials "SP" and the French assay mark 1819–39, almost certainly indicating it was made by high-society Parisian jeweller Simon Petiteau, probably during the 1820s and 1830s when the queen was living in Paris. Decades earlier, Désirée Clary – as she was known – the daughter of a wealthy French merchant, was engaged to Napoloen Bonaparte, who abruptly left her to wed Josephine de Beauharnais. Two years later, Désirée married General Jean-Baptiste Bernadotte, who, possibly at Napoleon's suggestion, was elected Crown Prince of Sweden. While Bernadotte spent much of his career on military campaigns, the queen lived mostly in Paris, where she is thought to have acquired the parure. Adding to the intrigue, Napoleon's wife Josephine also owned a malachite parure set with carved cameos.



Malachite Hall, Winter Palace, St Petersburg, Russia, designed in the 1830s by the architect Alexander Briullov and named after its malachite columns and fireplaces

Queen Desideria's parure, with malachite carvings featuring classical scenes from antiquity

Key dates

1777–1954

1750

1777 Désirée Clary is born in Marseille, France, to wealthy merchant François Clary and his second wife

1795 Napoleon Bonaparte becomes engaged to Désirée, but soon breaks off the engagement

1798 Désirée marries Jean-Baptiste Bernadotte, Napoleon's most accomplished general

1800

1810 Jean-Baptiste Bernadotte is elected Crown Prince of Sweden; Désirée becomes Crown Princess

1820–30 Parisian jeweller Simon Petiteau creates the malachite parure for the queen

1829 Désirée is crowned Queen Desideria of Sweden and Norway

1850

1860 On Desideria's death, the parure is inherited by Josephine, wife of Desideria's only son, Oscar I

1871 When Josephine dies, the necklace goes to Sofia, wife of Oscar II

1900

1913 After death of Sofia, her family donates the necklace to the Nordic Museum in Stockholm.

1950

1954 Jean Simmons plays Désirée Clary opposite Marlon Brando in the film biopic *Désirée*

2000

The film *Désirée*, based on the best-selling novel by Annemarie Selinko

> It was **my destiny to** be attractive **to heroes**
>
> Queen **Desideria**

Turquoise

△ **Cabochon** incorporating typical spider-web markings

Beads made from turquoise dating back to c.5000 BCE have been found in Mesopotamia (present-day Iraq), making it one of the first gems to be mined and cut. It is relatively soft and easy to work and can be polished, made into beads, carved, and used for cameos. For most gem uses, however, turquoise is cut *en cabochon*. It varies in colour from sky-blue to green, depending on the amount of iron and copper it contains. Turquoise is porous and its colour may deteriorate if worn frequently close to the skin.

Specification

Chemical name Copper aluminium phosphate | **Formula** $CuAl_6(PO_4)_4(OH)_8 \cdot 4H_2O$ | **Colours** Blue, green | **Structure** Triclinic **Hardness** 5–6 | **SG** 2.4–2.9 | **RI** 1.61–1.65 | **Lustre** Waxy **Streak** White-green | **Locations** Iran, China, USA, Mexico, Chile, Africa, Australia, Siberia, England, Belgium, France, Poland

Rough

Bisbee rough | This fine example from Bisbee, Arizona, US, shows the "spider webbing" (dark veining) typical of blue turquoise from that locality.

Turquoise rough | A piece of massive turquoise like this, with thin layers of the mineral interlayered with matrix, needs skilful cutting to extract the gem.

Cut

Pendeloque cabochon | The high-domed, tear-drop shaped cabochon cut of this classic Bisbee turquoise complements the gem's attractive black spider webbing.

Persian blue

Top of the range

Turquoise from Nishapur, Iran (formerly Persia), is considered by many to be the finest quality and has been mined for centuries. This turquoise, usually referred to as "Persian", tends to be harder and of a more even colour than North American turquoise, and it is always sky-blue, never green. Turquoise has embellished thrones, sword hilts, horse trappings, daggers, bowls, cups, and other ornaments over the centuries, as well as being used extensively in jewellery.

Persian ornament This ornament is engraved and inlaid with gold in the highest expression of the lapidary art.

Bisbee sample | This oval stone, naturally patterned with iron oxides, comes from the same type of turquoise as the Bisbee rough (above left).

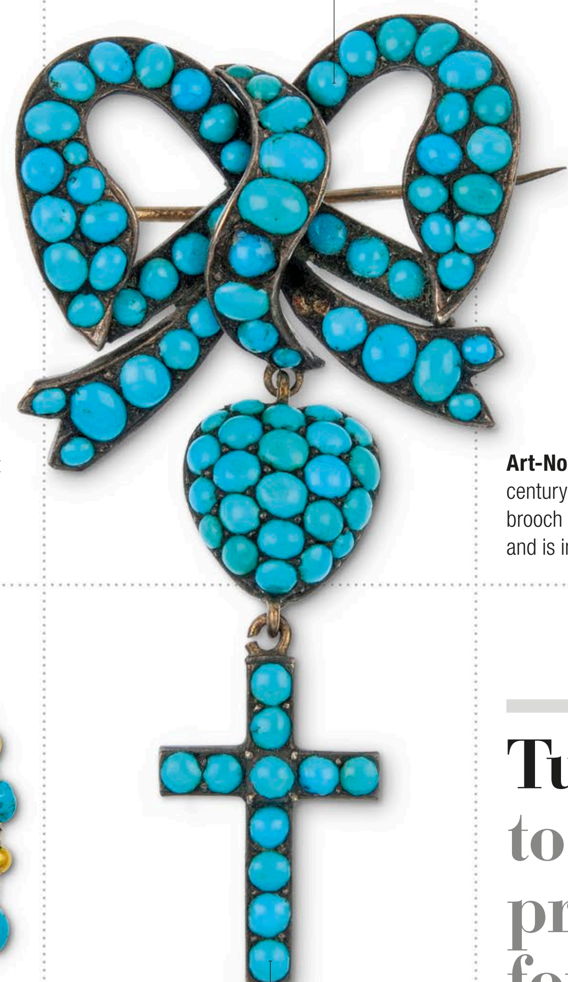
Imitation stone | This oval cabochon is cut from synthetic turquoise. It lacks the colour and texture of natural turquoise, though its uniform hue can be an advantage.

Settings

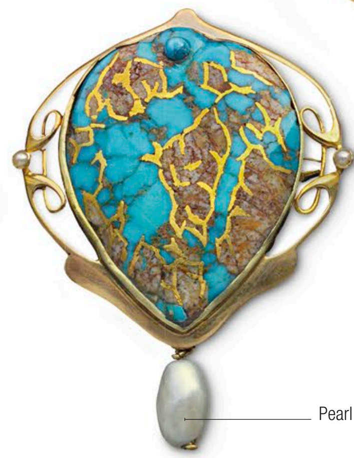
Vintage earrings | This pair of gold-mounted turquoise earrings comes from the British Arts and Crafts movement of the early 20th century.

Gold ring | The simplicity of this ring highlights the cushion-shaped Persian turquoise cabochon. The twisted bezel mount is a backdrop to the smooth, opaque stone.

Navajo bracelet | This large silver bracelet set with turquoise from Morenci, Arizona, USA, is typical of the bold pieces beloved of the Navajo people.



Late 19th-century memorial brooch | This silver and turquoise brooch, designed as a bow suspending a heart and a cross, has a hair panel to the reverse of the heart.



Art-Nouveau pendant | Made at the end of the 19th century, this rare gold and Arizona turquoise pendant/brooch has two side pearls and a suspended oval pearl, and is inlayed with gold.

Turquoise and gold necklace | Featuring irregular, polished turquoise nuggets, this necklace is interspersed with spherical and biconical gold spacers.

Turquoise first came to Europe via Turkey, probably accounting for its name, which is French for "Turkish"

Marie-Louise's diadem | c.1810 | Originally set with emeralds, subsequently set with turquise cabochons | Shown in a portrait by Giovanni Battista Borghesi – the artist has picked out the stones in red

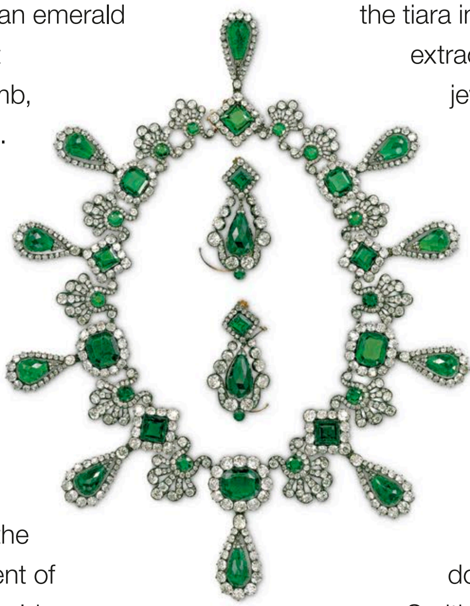
Marie-Louise's diadem

△ **Marie-Louise's diadem**, reset with turquoise cabochons

Few pieces of historic jewellery have undergone such a dramatic makeover as the Marie-Louise Diadem. Dating from 1810, the tiara was originally studded with 79 deep green Colombian emeralds totalling 700 carats. It is named after Empress Marie-Louise of France, who received the headpiece from her husband Napoleon I to mark their wedding in 1810. Made in Paris by Francois-Regnault Nitot of Etienne Nitot et Fils (which later became the jeweller Chaumet), it was part of an emerald and diamond parure that included a necklace, comb, belt buckle, and earrings.

When Napoleon's empire crumbled, Marie-Louise fled to Austria and, on her death, left the parure to her aunt, Archduchess Elise. However, in the 1950s, jewellery maker Van Cleef & Arpels acquired the diadem from a descendent of Elise, and removed and sold the emeralds at auction. The company advertised them with the catchphrase, "An emerald for you from the historic Napoleonic Tiara…" The gems consisted of a central emerald weighing 12 carats, along with 21 other large emeralds and 57 smaller ones.

Van Cleef & Arpels replaced the emeralds with 79 turquoise cabochons, a change that horrified some, but appealed to others. One such admirer was American socialite and breakfast cereal heiress Marjorie Merriweather Post. She purchased the tiara in 1971, adding it to her extraordinary collection of jewellery, which had included a 263-carat diamond necklace commissioned by Napoleon as a gift for Marie-Louise when she gave birth to their son in 1811 (see pp.284–85). After wearing the reworked turquoise diadem a few times, Merriweather Post donated it to the American Smithsonian Institution, where it can still be seen today.



Replica of the parure's emerald necklace

A turquoise given by a loving hand carries with it happiness and good fortune

Arabic proverb

Key dates

1810–1971

1810 Napoleon commissions the diadem as a gift for his second wife, Marie-Louise

1814 Marie-Louise returns to the family home in Vienna, taking her jewellery

1847 The diadem is bequeathed by Marie-Louise to her aunt, Archduchess Elise

French Emperor Napoleon I

Marjorie Merriweather Post

1953–56 Van Cleef & Arpels buys the diadem; the emeralds are removed and sold

1956–62 The emeralds are replaced with turquoises

1962 The parure is displayed at the Louvre, Paris

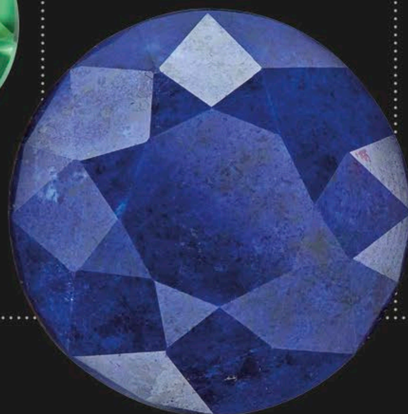
1967 The largest emerald from the diadem is set in a brooch for American philanthropist Sybil Harrington

1971 The diadem is bought by heiress Marjorie Merriweather Post for the Smithsonian Institution

Onyx (7th year)
A popular stone, onyx is commonly used in both men's and women's jewellery.

Tourmaline (8th year)
Its extraordinary range of colours makes tourmaline a wonderful anniversary stone.

Lapis Lazuli (9th year)
Prized for its stunning blue colour, lapis lazuli is the gem commonly used to mark the seventh year.



Diamond (10th year)
The diamond's link with the 10th anniversary is a modern idea, promoted by jewellers.

Turquoise (11th year)
Few gems have a longer pedigree than turquoise, which dates back to ancient Egypt.

Amethyst (6th year)
In more frugal times, the traditional gift for a sixth anniversary was iron. Amethyst is now the popular choice.

Gems for **anniversaries**

Stones have been assigned to planets**,** days of the week, and, most enduringly in modern times, to anniversaries. Many of the well-known gems and precious metals linked to five-yearly landmarks in longevity, such as 50 (gold) and 60 years (diamond) are also associated with anniversaries in the first 20 years. Like most lists of gems, definitions and interpretations can vary from one country to another, and likewise from dealer to dealer.

Sapphire (5th year)
In addition to the fifth anniversary, sapphires are also an alternative choice to mark the 23rd year.

Blue topaz (4th year)
Blue topaz was once rare, but with modern processes like irradiation, this is no longer the case.

Pearl (3rd year)
Once associated with the 30th anniversary, pearls are now the principal choice for the third year.

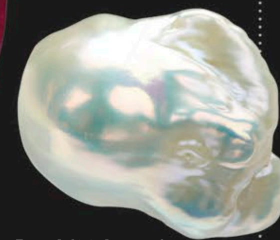
Garnet (2nd year)
A popular modern-day choice for the second year, garnet replaced the traditional gift of paper.

Gold (1st year)
Gold is also commonly associated with the 50th anniversary.

Jade (12th year)
Jade is a flexible gem that can be carved into a vast array of objects.

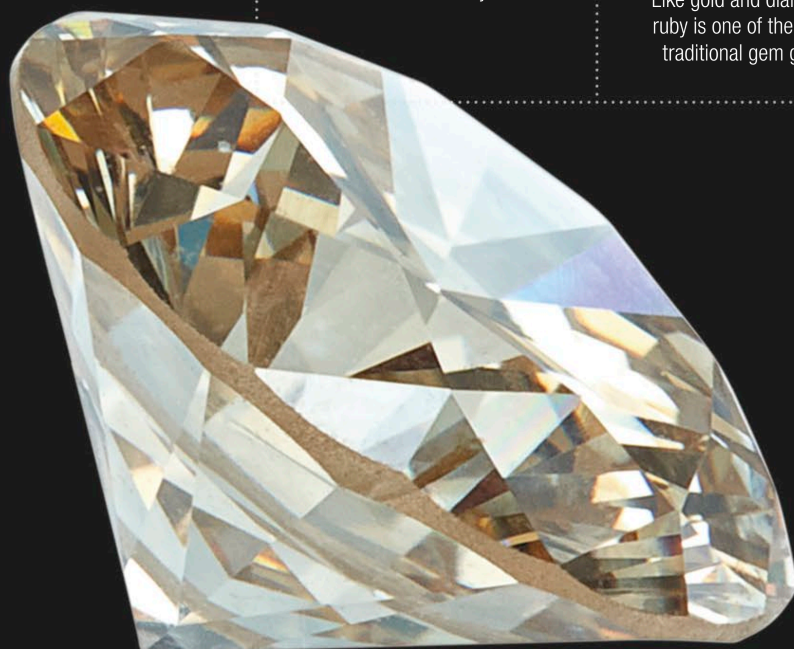
Gold (50th year)
In the Holy Roman Empire, wives were crowned with gold wreaths on their 50th anniversary.

Ruby (40th year)
Like gold and diamond, ruby is one of the more traditional gem gifts.



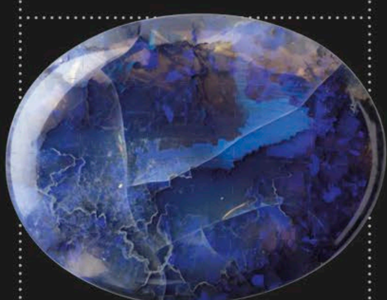
Pearl (30th year)
Prized for their rarity, pearls have been the traditional gift for a 30 year anniversary.

Citrine (13th year)
Named after the French word for “lemon”, citrine is often heat-treated to produce a more golden colour.



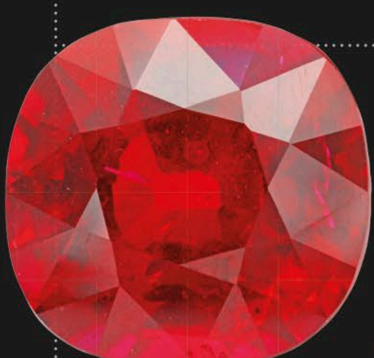
Diamond (60th year)
Its origin in the Greek word *adamas*, meaning enduring, makes diamond a fitting gift to mark this anniversary.

Silver (25th year)
In medieval Germany, silver wreaths were given to mark 25 years of marriage.



Opal (14th year)
Ivory was once the choice for the 14th year, but for conservation reasons, opals are now given.

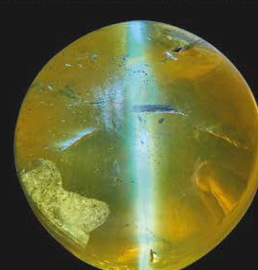
Emerald (20th year)
Replacing china, emerald is now the standard gift for a 20th anniversary.



Ruby (15th year)
Originally used to mark 40 years of marriage, rubies are now the gift for a 15th anniversary.

Peridot (16th year)
Peridots have rather exotic associations, having sometimes been found in meteorites.

Quartz (17th year)
Watches were once the traditional 17th-year gift: the modern choice of quartz may be a link to a watch’s quartz movement.



Chrysoberyl (18th year)
The attractive cat’s eye chrysoberyl is the official gemstone for 18th anniversaries.

Aquamarine (19th year)
Aquamarine, with its glorious sea-blue colouring, makes for a wonderful 19th-anniversary gift.

Brazilianite

△ **Pale yellow** brazilianite rough

Brazilianite was only discovered and named – after the South American country of its discovery – in 1945, making it a relatively "new" gemstone. Most brazilianite is chartreuse-yellow to pale yellow in colour, and it is relatively hard for a phosphate mineral; it is also brittle. It is scarce, and very little gem-grade material is found each year. Because of these factors, it is faceted only for collectors. Since brazilianite was recognized, small amounts of the gem have also been found in Maine and New Hampshire in the USA.

Specification

Chemical name Sodium aluminium phosphate | **Formula** $NaAl_3(PO_4)_2(OH)_4$ | **Colours** Yellow, green | **Structure** Monoclinic | **Hardness** 5.5 | **SG** 3.0 | **RI** 1.60–1.62 | **Lustre** Vitreous | **Streak** Colourless | **Locations** Brazil; Maine and New Hampshire, USA

Prismatic crystals | **Rough** | This group of finely formed, prismatic brazilianite crystals with accessory apatite orginates from Minas Gerais, Brazil.

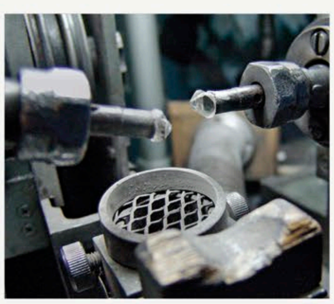
Crystal | **Rough** | This strikingly coloured lime green brazilianite crystal comes from the Brazilian state of Minas Gerais. It is part of the Smithsonian's gem and mineral collection.

Emerald cut | **Cut** | For this faceted gem, the cutter has chosen a step-cut variety – the emerald cut – to emphasize the stone's fine colour and transparency.

Cutting brazilianite

Handled with care

Vivid yellow brazilianite's beautiful appearance would make it a popular gem, were it not for two factors – its fragility and its brittle texture. To cut it, the lapidary (gem-cutter) usually sticks the stone to its holder with easily removable adhesive, and must take great care not to knock it against anything. Likewise, any vibration in the grinding and polishing stages will shatter the brittle stone. The high level of skill required means that faceted stones are comparatively rare.



Gem cutting Brazilianite requires extreme care in cutting, or its brittleness will cause it to shatter.

Fancy cut | **Cut** | Featuring a classic example of a fancy cut, this yellow brazilianite gemstone has been faceted in a traditional triangular step cut.

Brilliant cut | **Cut** | This greenish brazilianite is faceted in a standard brilliant cut with 52 facets, as opposed to the 58-facet version, which is more common.

Amblygonite

△ **Transparent, coloured** amblygonite rough

The Greek words *amblus* ("blunt") and *gouia* ("angle"), are the origin of amblygonite's name – an allusion to the shape of its crystals. Most amblygonite is found as large, white, translucent masses, and it is often used as a rich source of lithium. Gem-quality amblygonite is less common and tends to be transparent, with a yellow, greenish-yellow, or lilac colour. Although it can be faceted and used as a gemstone, it is vulnerable to breakage and abrasion from general wear when set into jewellery, and so is cut principally for collectors.

Specification

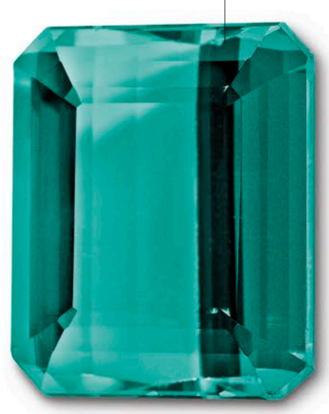
Chemical name Lithium, sodium alumino-phosphate
Formula (Li,Na)AlPO$_4$(F,OH) | **Colours** White, yellow, lilac
Structure Triclinic | **Hardness** 5.5–6 | **SG** 3.0–3.1
RI 1.57–1.64 | **Lustre** Vitreous to greasy or pearly
Streak White | **Locations** France, Brazil; California, USA

Amblygonite rough | **Rough** | The transparency of this piece of amblygonite rough is obscured by the reflections from its uneven surface.

Amblygonite with wavellite | **Rough** | In this example, the raw amblygonite has coated another phosphate mineral, wavellite, with a translucent layer.

Brilliant oval | **Cut** | The clarity and flawlessness of this colourless amblygonite is brought out by a simple yet effective, oval brilliant cut.

The largest documented single crystal of amblygonite measured 15m³ (530ft³)



Emerald cut | **Cut** | The use of a classic emerald step cut emphasizes the extremely rare blue-green colouring of this amblygonite stone.

Yellow-green transparent | **Colour variety** | The cutter of this oval amblygonite has added a number of extra facets to the brilliant cut, to maximize the play of light and so bring out the stone's subtle colouring.

Apatite

△ **Fine, medium-blue, step-cut** oval apatite

The name apatite is derived from the Greek *apate*, meaning "deceit", as it often resembles the crystals of other minerals such as aquamarine, amethyst, and peridot. It can be intensely coloured, occurring in vivid greens, blues, violet-blues, purples, and rose-reds. As a relatively soft crystal, it is not widely used as a gemstone, and although transparent apatite is sometimes faceted and mounted in jewellery, care must be taken when wearing it as it can scratch. Some of the largest apatite crystals have been found in Canada, weighing up to 200kg (485lb).

Specification

Chemical name Fluorapatite, chlorapatite, hydroxyapatite
Formula $Ca_5(PO4)_3(F,OH,Cl)$ | **Colours** Various | **Structure** Hexagonal or monoclinic | **Hardness** 5 | **SG** 3.1–3.2
RI 1.63–1.64 | **Lustre** Vitreous, waxy | **Streak** White
Locations Madagascar, Brazil, Myanmar, Mexico

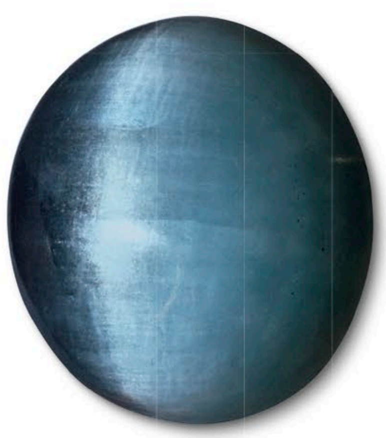
Muscovite or common mica crystals

Apatite and muscovite | **Rough** | Fine green apatite crystals can be seen growing within the white tabular muscovite, or mica, crystals in this rough specimen.

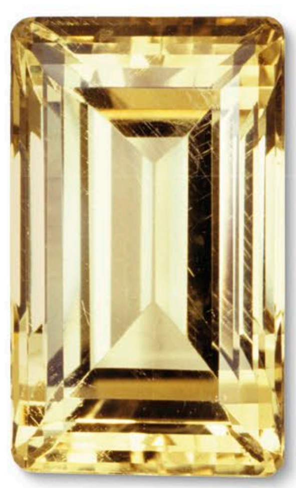
Apatite in calcite | **Rough** | Apatite is found in a number of geological environments, seen here as green crystals within a calcite groundmass.

Prismatic crystal | **Rough** | Apatite can look deceptively similar to other crystals. To an amateur, the blue crystals here could be mistaken for aquamarine.

Mexican apatite | **Rough** | Yellow apatite crystals, such as this Mexican example with a pyramidal end and a hexagonal prism, is popular with collectors and jewellery-makers.



Cabochon of apatite | **Cut** | An attractive dark blue specimen, this apatite has been cut and polished *en cabochon* and shows a cat's eye effect.



Step-cut apatite | **Cut** | Yellow apatite crystals from Durango, Mexico, were often faceted into fine gems, such as this rectangular step-cut stone.

Oval brilliant | **Colour variety** | Apatite gems displaying a fine blue colour, such as this 6.16-carat blue oval brilliant, are among the most popular varieties.

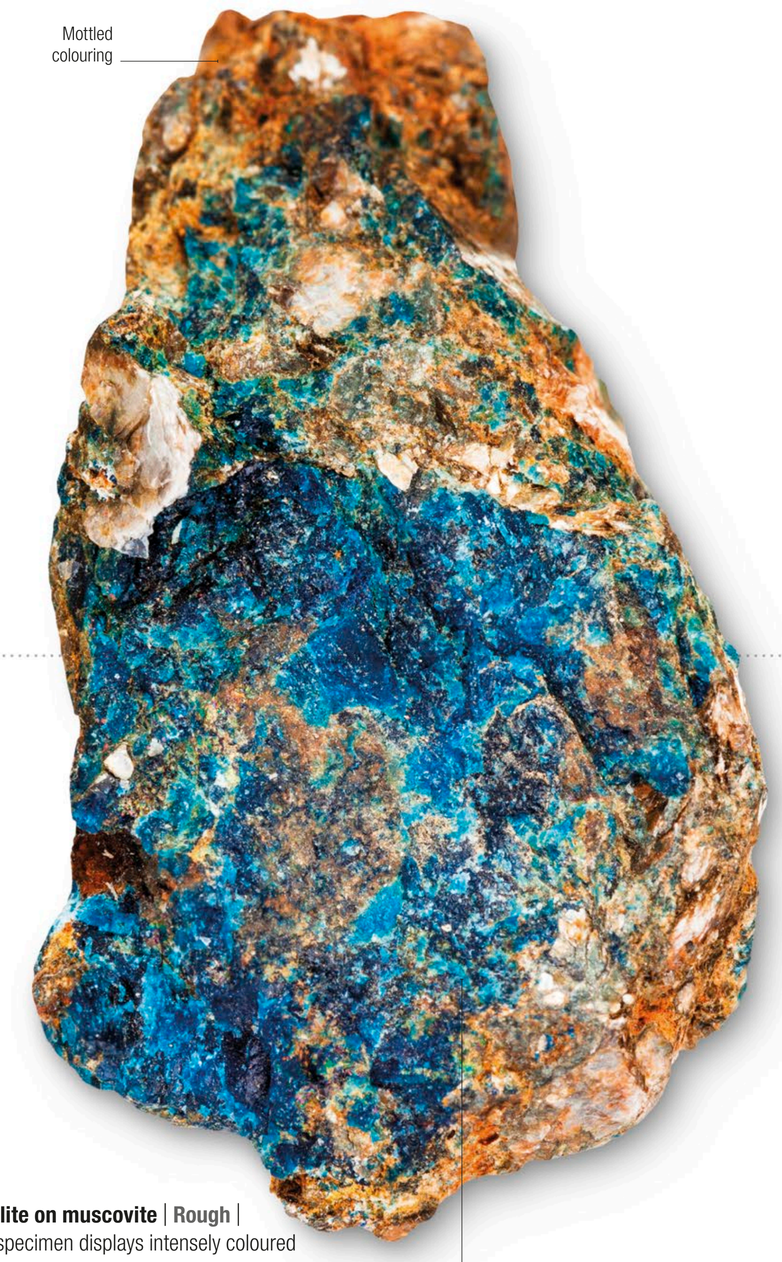
Lazulite

△ **Single, dipyramidal crystal** of lazulite from Afghanistan

Lazulite takes its name from the old German word *lazurstein*, meaning "blue stone". It is usually azure blue, sky blue, bluish white, or blue green. Rare faceting material is sometimes found, which can appear blue or white, depending on the angle it is viewed from. Granular lazulite is cut *en cabochon*, and can be tumble polished; it is sometimes fashioned into beads and carved into artefacts. Its appearance can be similar to lapis lazuli (see pp.174–77), and it is sometimes confused with lazurite (the main component of lapis lazuli) or azurite.

Specification

Chemical name Magnesium aluminium phosphate | **Formula** $(Mg,Fe)Al_2(PO_4)_2(OH)_2$ | **Colours** Various shades of blue **Structure** Monoclinic | **Hardness** 5–6 | **SG** 3.1 | **RI** 1.61–1.64 | **Lustre** Vitreous | **Streak** White | **Locations** Sweden, Austria, Switzerland, Canada, USA, Afghanistan



Lazulite on muscovite | **Rough** | This specimen displays intensely coloured lazulite crystals encrusting muscovite mica, accompanied by pink feldspar.

Crystals in matrix | **Rough** | Afghanistan has produced some of the finest crystals of lazulite ever found, such as these specimens in a matrix of quartz.

A single crystal | **Rough** | This finely-formed single crystal of lazulite in quartz from Afghanistan features a perfect dipyramidal form.

Lazurite | **Rough** | The intense blue colour displayed in this example of lazurite rough from Chile reveals how easily it can be confused with lazulite.

Cabochon | **Cut** | A typically mottled blue appearance is enhanced by this low-domed cut *en cabochon,* which also shows off the stone's vitreous lustre.

Baryte

△ **Baryte rough** on sphalerite

The name "baryte" originates from the Greek *barys*, meaning "heavy", a reference to the mineral's high specific gravity. It is very soft and breaks readily in a number of directions – it is faceted with difficulty, purely as a collector's gem. Golden baryte from Colorado, USA, is the most prized gemstone colour; blue baryte is also faceted for collectors. Baryte is found in the form of stalactites, too, and round, banded sections of these are sometimes polished and mounted in silver frames as pendants. It is the most important single source of barium (see box, below).

Specification

Chemical name Barium sulphate | **Formula** $BaSO_4$
Colours Colourless, golden, bluish, greenish, beige | **Structure** Orthorhombic | **Hardness** 3–3.5 | **SG** 4.5 | **RI** 1.63–1.65
Lustre Vitreous, resinous, pearly | **Streak** White | **Locations** England, Italy, Czech Republic, Germany, Romania, USA

Golden colouring

Prismatic crystals | **Rough** | This group of baryte crystals exhibits a prismatic form and the resinous lustre characteristic of the mineral.

Tabular crystals

Golden baryte crystals | **Rough** | The golden baryte material that is mined near Canyon City, Colorado, USA, is world-famous for its crystal forms and colours, as can be seen in this brightly coloured specimen.

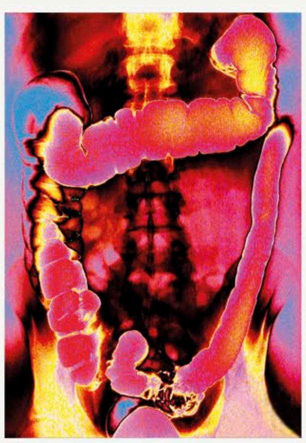
Flake-like form

Baryte crystals | **Rough** | Originating from Wet Grooves Mine, Yorkshire, UK, this specimen consists of a large group of tabular baryte crystals.

Medicine and industry

Baryte and barium

Baryte powder is used in medicine as a "barium meal" for imaging the stomach and intestine. It is also an important mineral in oil and gas production, used as drilling mud to seal boreholes and prevent oil or gas blowout in oil- and gas-wells, which accounts for about 70 per cent of its industrial output. It is also used as a filler in paper- and cloth-making, and as an inert body in coloured paints.



Barium meal Barium sulphate is visible in X-rays when ingested by the patient.

Baryte crystal | **Rough** | This tabular, double-ended crystal shows some damage on its left side. Growth zones can be seen in pale banded sections at its base.

Rectangular table facet

Mixed cut gemstone | **Cut** | Baryte is one of the most difficult of all collector's gems to facet. The cutter has done a fantastic job with this stone.

Celestine

△ **Crystallized** blue celestine

Celestine often forms beautiful, transparent, light to medium-blue crystals – if it were harder and more durable, it might be one of the world's favourite gemstones. It takes its name from the Latin *coelestis*, meaning "heavenly", an allusion to its "heavenly" sky-blue crystals. Because celestine is soft and easily broken, it is faceted only for collectors and museums by skilled lapidaries. Single crystals are sometimes sold as pendants, but they are too fragile for general wear. Facet-grade material is found in Namibia and Madagascar.

Specification

Chemical name Strontium sulphate | **Formula** $SrSO_4$ | **Colours** Colourless, red, green, blue | **Structure** Orthorhombic | **Hardness** 3–3.5 | **SG** 4.0 | **RI** 1.62–1.64 | **Lustre** Vitreous, pearly on cleavage | **Streak** White | **Locations** USA, Namibia, Madagascar

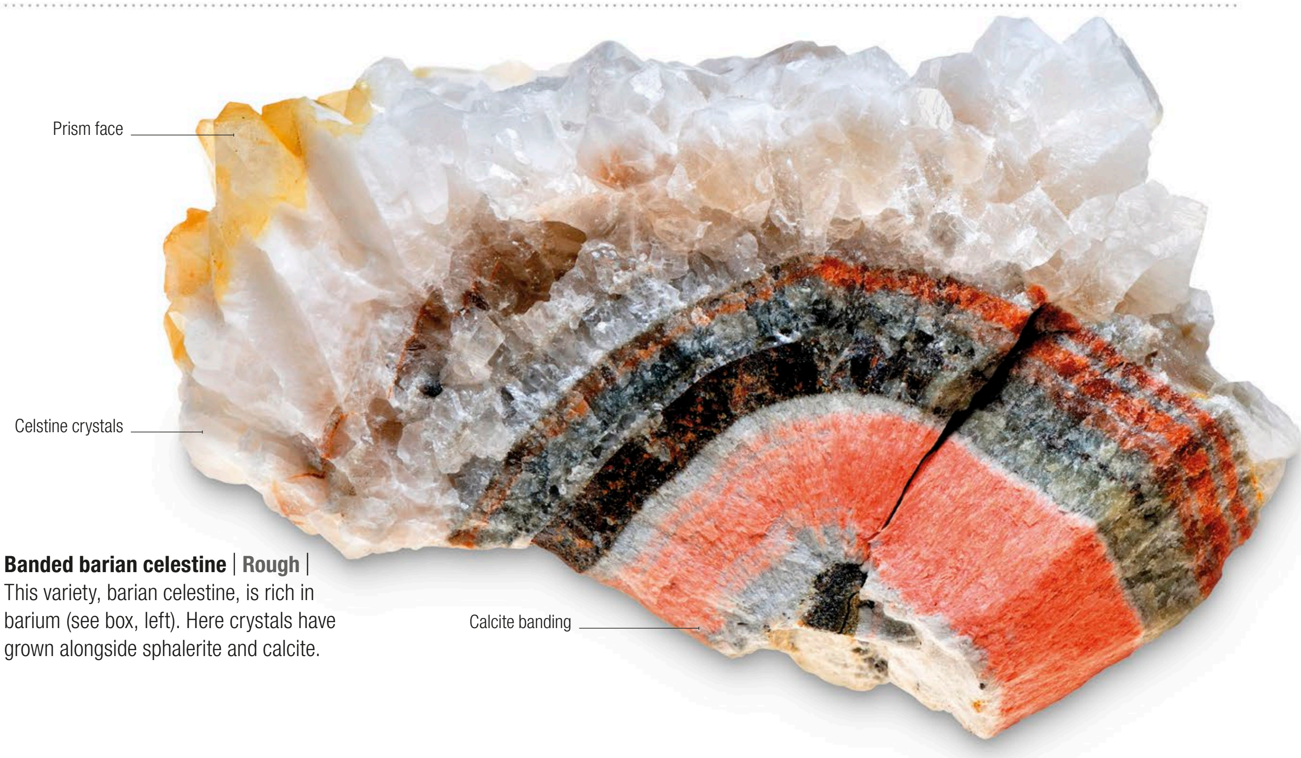
Crystals on sulphur groundmass | **Rough** | This group of very light blue celestine crystals is growing at all angles off a sulphur groundmass.

Fine crystals | **Rough** | These small but perfectly crystallized celestine crystals have formed on a sheet of the iron oxide mineral limonite.

"Heavenly" crystals | **Rough** | These stunning dark blue crystals from Madagascar live up fully to the name celestine, derived from the Latin for "heavenly".

Double-terminated crystal | **Rough** | This unusual bi-coloured celestine crystal is double-terminated, meaning it has termination faces on both ends.

Mixed-cut gem | **Cut** | Celestine is another of the extremely hard-to-cut collector's gems; this mixed cut shows the very high skill of the cutter.



Banded barian celestine | **Rough** | This variety, barian celestine, is rich in barium (see box, left). Here crystals have grown alongside sphalerite and calcite.

Alabaster

△ **Specimen** of rough gypsum alabaster

Fine-grained masses of gypsum are known as alabaster. The origin of the word is probably Middle English, but is ultimately derived from the Greek *alabastos*, a term referring to a vase made of alabaster. Alabaster vessels called *a-labaste* were widely used by worshippers of the goddess Bast in ancient Egypt, which may also reflect the origin of the name. Alabaster has been carved into ornaments, containers, and even utensils, for thousands of years, and it is sometimes made to look more like marble by heat-treating it to reduce translucency.

Specification

Chemical name Calcium sulphate hydrate | **Formula** $CaSO_4 \cdot 2H_2O$ | **Colours** Colourless, white, yellow, light brown | **Structure** Monoclinic | **Hardness** 2 | **SG** 2.3 | **RI** 1.52–1.53 | **Lustre** Subvitreous to pearly | **Streak** White | **Locations** Egypt, Italy

Italian alabaster | **Rough** | While Italian marble is famous worldwide, the country's fine alabaster is less well known. These pieces of Italian rough have an almost wax-like appearance.

Calcite alabaster jar | **Carved** | Calcite alabaster was widely used in ancient Egypt (see box). This canopic jar of Psamtikpadineith is from the 26th Dynasty, c.600 BCE.

Alabaster bust | **Carved** | This Italian gilt alabaster bust dates back to around 1900, and is modelled in the style of a Renaissance maiden.

Calcite alabaster

Alabaster in Tutankhamun's tomb

Even today, ancient items produced from banded calcite are still referred to as being made from "calcite alabaster". A famous ancient source of this was Hattsub, Egypt, and it is likely that some of the alabaster objects in Tutankhamun's tomb were carved in stone from this source, particularly the vases and canopic jars that held his internal organs. It was also used to make buildings, bowls, the inlaid eyes of statues, and more.

Egyptian carving An elaborately decorated ancient Egyptian casket carved from calcite alabaster

Ancient vase | **Carved** | This early vase was carved from alabaster in the ancient city of Ur (now in Iraq) some time in the 2nd millennium BCE.

Alabaster bust | **Carved** | This bust in Italian alabaster by the 18th-century artist Giovanni Battista Cipriani shows the delicate tones and fine detail possible in alabaster carvings.

Gypsum

△ **Example** of rough satin spar gypsum

Transparent crystals of gypsum are called selenite, named after the Greek moon goddess, Selene. The name may originate from the ancient belief that certain transparent crystals waxed and waned with the moon, and the crystal is still popular with enthusiasts of spiritual gems. A fibrous variety of selenite with a silky lustre is known as "satin spar"; when cut *en cabochon*, fibrous gypsum produces a cat's eye effect, but it is too soft for general wear.

Specification

Chemical name Calcium sulphate hydrate | **Formula** $CaSO_4{\cdot}2H_2O$ | **Colours** Colourless, white | **Structure** Monoclinic | **Hardness** 2 | **SG** 2.3 | **RI** 1.52–1.53 | **Lustre** Subvitreous to pearly | **Streak** White | **Locations** Mexico, USA

Fishtail twin | **Rough** | Twin crystals of gypsum growing in mirror image along a centre line such as this are referred to as fishtail twins.

Gypsum crystals | **Rough** | These gypsum crystals growing from a rock groundmass have their faces highlighted by an iron oxide coating.

Desert rose | **Rough** | Spherical aggregates of gypsum crystals, such as this, that form in some relatively dry climates are called "desert roses", a reference to the flower-like appearance of their crystals.

Selenite crystal | **Rough** | Transparent or highly translucent gypsum is called selenite, and has several crystal forms, one of which is shown here.

Satin spar | **Cut** | Gypsum sometimes forms masses of long, parallel crystals known as satin spar, and shows an "eye" when cut *en cabochon*, as here.

SACRED STONES

The Bible is full of references to precious gems – sapphires, diamonds, rubies, and pearls in particular. In both the Old and New Testaments, jewels are used as a metaphor to express how beautiful heaven will be. As a consequence, early medieval churches often used gems in their regalia, to decorate altars, and on the special vessels and vestments used in church services and processions. Some of the larger European monasteries had their own goldsmiths, and secular goldsmiths were also commissioned to make sacred, jewel-studded treasures.

Jewels also played a role in the Christian tradition of holy relics – the remains of a holy person, or objects they had touched – which were considered to be a bridge between heaven and earth and were the church's most valuable possessions. Skeletons believed to be saintly relics were draped in jewellery of gold, silver, and precious stones, while smaller relics were housed in ornate reliquaries (see pp.144–45). These containers made from precious metals and gems were often donated by pious worshippers and pilgrims. Such artefacts were intended to be physical manifestations of the spiritual treasures of the afterlife.

I will make your battlements of rubies, your gates of carbuncles... all your walls of precious stones

The **Bible**, Isaiah 54:11-12

The *Adoration of the Mystic Lamb* by Hubert and Jan van Eyck
Painted in 1432 by the van Eyck brothers for the altar of St Bavo Cathedral, Ghent, in the Netherlands, this oil painting shows luminous jewels set into the regalia of popes, bishops, and deacons.

Scheelite

△ **Specimen of scheelite** in a rock groundmass

Crystals of scheelite can be opaque or transparent. The latter are sometimes cut as gemstones for collectors, and these exhibit almost as much dispersion (fire) as diamond. For this reason, synthetic colourless scheelite is sometimes used as a diamond simulant, although it is too soft to wear well. Synthetic scheelite is also coloured by trace elements to simulate other gemstones. Opaque crystals can grow very large – some weighing up to 7kg (15lb) come from Arizona, USA. Most scheelite crystals fluoresce under ultraviolet light.

Specification

Chemical name Calcium tungstate | **Formula** $CaWO_4$ **Colours** Yellow, white, pale green, orange | **Structure** Tetragonal **Hardness** 4.5–5 | **SG** 5.9–6.3 | **RI** 1.92–1.94 | **Lustre** Vitreous to greasy | **Streak** White | **Locations** Austria, Italy, Brazil, Rwanda, USA, UK, China

Scheelite on muscovite | **Rough** | In this specimen originating from China, a large crystal is seated on a groundmass of muscovite, a common variety of mica.

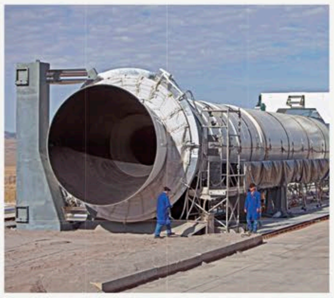
Crystals in matrix | **Rough** | This specimen consists of scheelite crystals resting on a groundmass of magnetite. The crystals are bipyramidal in shape.

Gem crystal | **Rough** | This finely formed, gemmy scheelite crystal originates from a major scheelite deposit location in China. Stones such as this can be cut into gems.

Tungsten

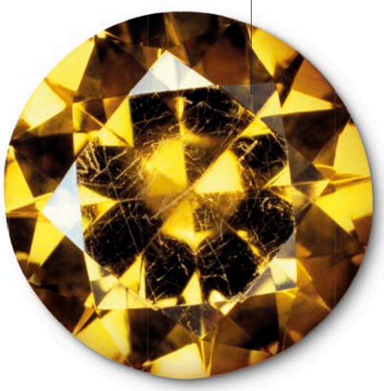
Turning up the heat

Scheelite is a major source of tungsten, which has the highest melting point of all elements and is a vital part of modern industry. Electric light filaments are made from pure tungsten, while tungsten carbide is used in drill bits, dies, and tools for shearing metal; cobalt-chromium-tungsten alloys are used in the surfaces of wear-resistant valves, bearings, propeller shafts, and cutting tools. Tungsten steel is used in high-temperature hardware such as rocket nozzles.



Rocket nozzle High-temperature alloys such as this rocket nozzle depend on tungsten derived from scheelite.

Orange crystal | **Colour variety** | This large, finely transparent crystal is notable for its vivid orange colouring. A stone such as this would flouresce under ultraviolet light.



Brilliant cut | **Cut** | The cut of this fine, brilliant-cut, yellow-brown scheelite gem enhances the high reflectivity associated with this type of mineral.

Howlite

△ **Several nodules** of howlite on a rock matrix

Popular with collectors, howlite is generally found in nodules, in which it is usually white with veins of other minerals running through it. It is relatively porous and absorbs dye well, in particular blue dye: when altered in this way, it resembles, and is sometimes erroneously sold as, turquoise. Fortunately it is easily distinguished from turquoise since it is much softer, although it can still be polished. Howlite is found in quantity in Death Valley, California, USA. It was named after the Canadian chemist, Henry How, who discovered it in 1868.

Specification

Chemical name Calcium borosilicate | **Formula** $Ca_2B_5SiO_9(OH)_5$ | **Colours** White | **Structure** Monoclinic | **Hardness** 3.5 | **SG** 2.6 | **RI** 1.58–1.61 | **Lustre** Subvitreous | **Streak** White | **Locations** USA, Canada, Mexico, Germany, Russia, Turkey

Howlite nodule | **Rough** | Howlite is sometimes found in cauliflower-like nodules like this one, which can be dyed to resemble turquoise nuggets (see far right).

Polished pebble | **Cut** | A tumble-polished example of natural, uncoloured howlite showing the veining common in many specimens.

Dyed and tumbled | **Cut** | A popular form of howlite for collectors, many specimens are tumbled and dyed various shades of blue-green to resemble turquoise.

Dyed howlite | **Cut** | This tumble-polished specimen of howlite has also been dyed to look like turquoise, with a different shade and a more highly polished surface.

Howlite pendant | **Carved** | This finely sculpted, veined howlite horse-head carving featuring onyx eyes is set in a frame fashioned from 18-karat gold.

Carved frog | **Carved** | Howlite is soft but tough, which means it makes an excellent material for carving. This fanciful, veined howlite frog carving has a smooth surface and is set with onyx cabochons for eyes.

Enamel pelican on square-cut ruby | Shown here hanging from a gold-set diamond amid pearls in a portrait of Queen Elizabeth I attributed to Nicholas Hilliard, c.1573–75

Queen Elizabeth's pelican brooch

△ **Enamel pelican**, Elizabeth I's signature emblem

While much is known about the symbolism of Queen Elizabeth I's pelican brooch, information on the piece itself is scant. The last known image of it is the *Pelican Portrait of Queen Elizabeth I,* attributed to artist Nicholas Hilliard. The painting was produced around halfway through Elizabeth's reign, when she was around 40 years old, a time when religious iconography became more important to her public portrayal. In the painting, the brooch is fastened to Elizabeth's richly adorned dress and depicts a pelican with a bloodied breast and her young around her. The enamel pelican hangs from a square-cut diamond set in gold and rests atop a square-cut ruby.

Elizabeth is known to have favoured two symbols – the phoenix and the pelican. While the former signified her endurance and her long reign, the pelican symbolized her devotion to her subjects. In ancient legend, it was thought that a mother pelican, in times of scarcity, will peck at her body in order to feed her young with her own blood, perhaps based on the way pelicans press their bills against their breasts to fully empty food from their throat pouches. This legend, which predates Christianity, was adopted by early Christians to represent Christ's sacrifice and the gift of his body and blood in the Eucharist – he was sometimes referred to as "the Pelican".

Elizabeth adopted the symbol, wishing to be seen as the selfless mother of her people, placing her subjects' needs before her own. Her courtiers, aware of her personal adoption of these emblems, gave her gifts of pelican and phoenix jewellery, such as appear in this portrait and in Hilliard's matching *Phoenix Portrait*.

Van Cleef & Arpels clip featuring the pelican motif

Key dates

1558–1603

1550

1558 On 17 November, Elizabeth I ascends to the throne

1560

1572 Nicholas Hilliard paints a miniature of Queen Elizabeth, who adopts the pelican as her religious symbol

1570

c.1573 The matching *Phoenix Portrait* is painted around the same time as the *Pelican Portrait*

c.1573 The *Pelican Portrait* is painted, featuring the pelican brooch

1580

Phoenix Portrait, c.1575, attributed to Nicholas Hilliard

1590

1600

24 March 1603 Queen Elizabeth dies

1610

Artist Nicholas Hilliard (1547–1619), famed for his portraits of Elizabeth I

… that good Pelican that to feed her people spareth not to rend her own person

John **Lyly**

English writer, c.1553–1606, on Queen Elizabeth I

Mysticism and **medicine**

Since ancient times, gemstones have been regarded as talismans, warding off the evil eye and protecting the wearer from illness. Medieval alchemists ascribed curative properties to gems, and rich patients were given powdered stones as medicine. New Age practitioners today believe that crystals have healing powers when placed against the body – although there is no medical evidence for this.

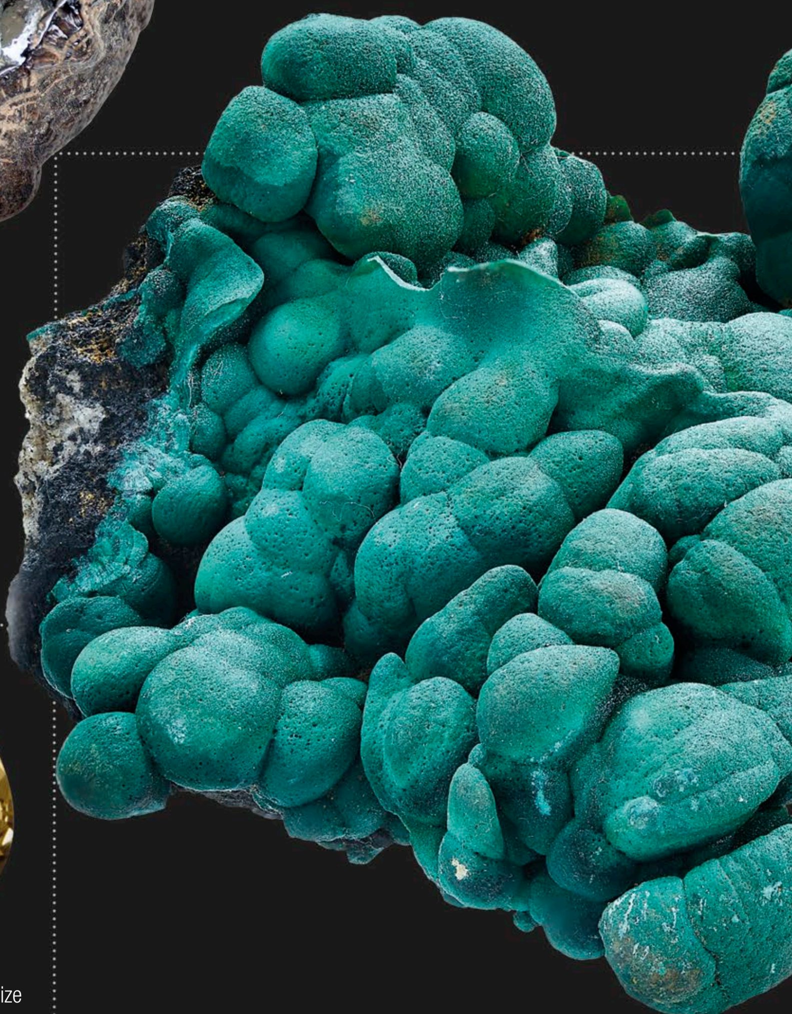
Diamond
The Greeks believed that diamonds were the tears of the gods, the Romans that they were splinters of fallen stars.

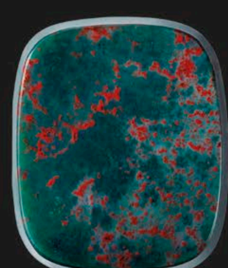
Hematite
A popular ancient belief stated that hematite formed on battlefields where soldiers' blood had been spilled.

Ruby
In ancient lore, rubies were thought to be petrified drops of the blood of dragons.

Pearl
Pearls are still used in medicine, ground to a powder and used as pharmaceutical calcium.

Blue sapphire
Ancient Egyptians used blue sapphire as an antidote to poison and to treat eye problems.





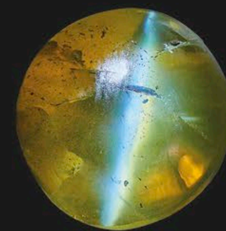
Bloodstone
Medieval legend holds that bloodstone was formed when drops of Christ's blood fell on the ground.

Yellow sapphire
Yellow sapphire is said to energize relationships and strengthen the wearer's inner will.

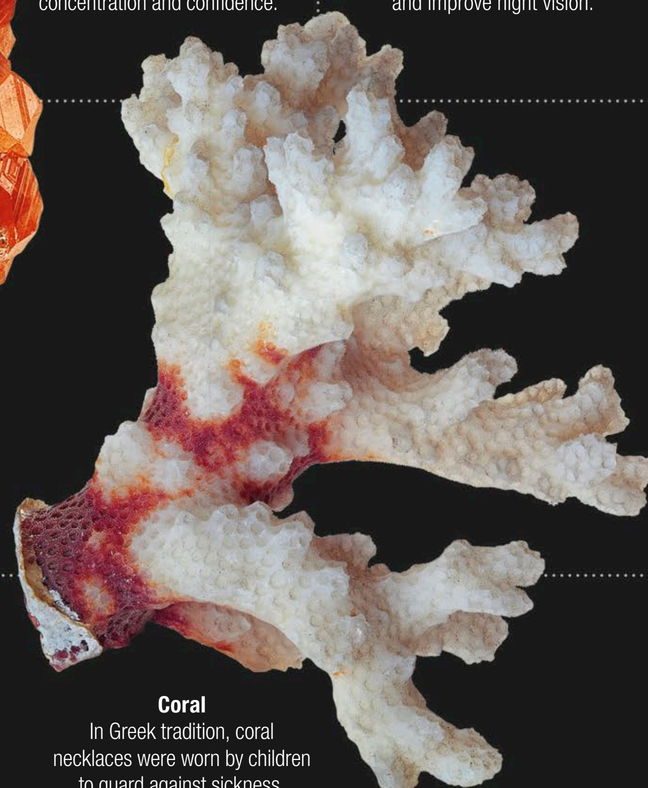
Emerald
In Roman mythology, emeralds were were said to change colour if a lover was unfaithful.

Hessonite
In Vedic astrology, hessonite is said to promote longevity and success.

Chrysoberyl
In healing crystal lore, chrysoberyl is said to boost concentration and confidence.

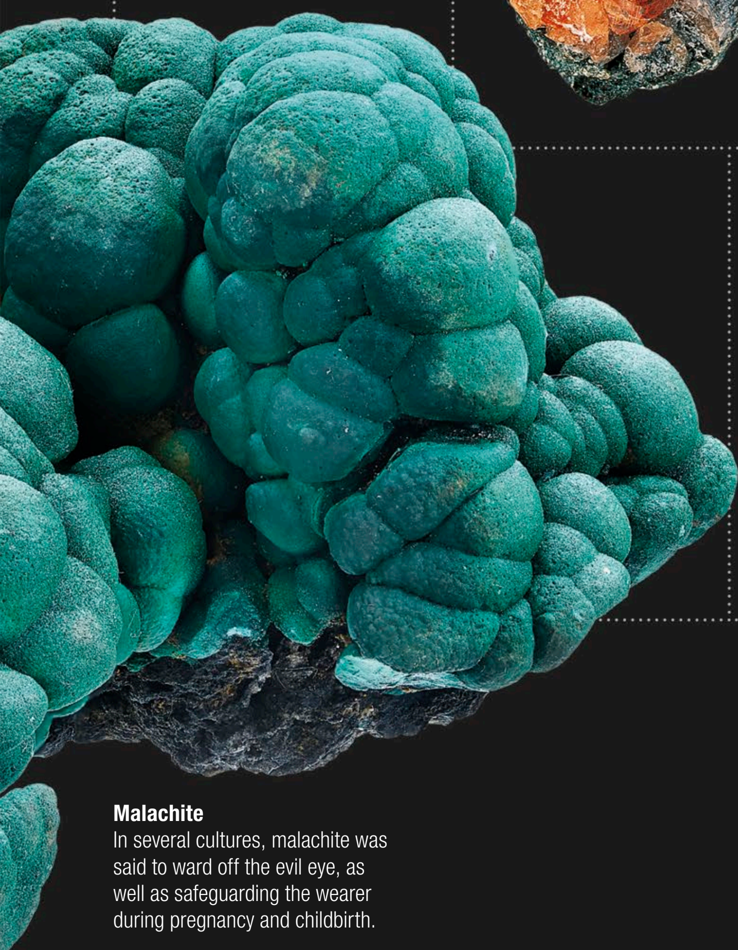


Cat's eye
The chrysoberyl variety of cat's eye is said to relieve headaches and improve night vision.



Coral
In Greek tradition, coral necklaces were worn by children to guard against sickness.

Zircon
In the East, zircon was employed as a talisman, protecting travellers from wild animals and snakebites.



Malachite
In several cultures, malachite was said to ward off the evil eye, as well as safeguarding the wearer during pregnancy and childbirth.

Philip II of Spain was prescribed the **Most Noble Electuary of Jacinth** – a cocktail of **gems** including **zircon** (jacinth). **He died** two days later

Edwardian amethyst brooch | This stunning Brazilian amethyst and diamond brooch features a 96-carat, heart-shaped amethyst surrounded by diamonds, set in gold and platinum.

Amethyst dissipates evil thoughts and quickens the intelligence

Leonardo **Da Vinci**
Artist and inventor

Quartz

△ **Brazilian amethyst crystal**, with broken base

Quartz is the third most common mineral on the Earth's crust, after ice and feldspar. Of all minerals, it has the greatest number of gem varieties, including prized gems such as amethyst, chalcedony, and agate. Quartz comes in two basic forms: crystalline (as distinct crystals), and cryptocrystalline (formed of microscopic crystalline particles). The optical and electrical properties of colourless, transparent quartz have led to its extensive use in lenses and prisms, and as oscillators for electronic devices such as watches.

Stone of wonder

The word "quartz" comes from Old German and first appears in the writings of Georgius Agricola in 1530. However, long before this, Roman naturalist Pliny the Elder (23–79 CE) believed quartz to be ice that had been permanently frozen after great lengths of time, his evidence being that quartz is found near glaciers in the Alps, but not on volcanic mountains. Egg-sized, white quartz pebbles are found in Bronze-Age tombs in Europe, and in early Christian churches and chapels in Ireland and the North of England. Even now, rock crystal – transparent, colourless quartz – is commonly regarded in shamanistic practice as a "light-stone", an instrument of clairvoyance between the visible and invisible. Australian Aborigines used rock crystal both as a talisman and to produce visions, while the Navajo believed that it first caused the Sun to cast its light upon the world.

Specification

Chemical name Silicon dioxide | **Formula** SiO_2 | **Colours** All colours | **Structure** Trigonal | **Hardness** 7 | **SG** 2.65 **RI** 1.54–1.55 | **Lustre** Vitreous | **Streak** White

Locations
1 Brazil **2** Scotland **3** Spain **4** France **5** Swiss Alps **6** Russia **7** Sri Lanka **8** Madagascar

Settings

Amuletic pendant | **Set** | This ancient amulet from the Egyptian New Kingdom takes the form of a lion's head carved from amethyst, set on a gold base featuring baboon figures. It dates from around 700 BCE.

Crystal ewer | **Carved** | This stunningly crafted ewer was carved and hollowed from a single piece of rock crystal in the Fatimid Period (969–1161 CE) in Egypt, the source of a number of rock crystal artefacts.

Duchess of Windsor's Cartier necklace | **Set** | Incorporating 29 smaller, step-cut amethysts and a large, central heart-shaped amethyst gem, this bib necklace is also set with turquoise and diamonds.

Rough

Rock crystal on agate | This cross-sectional mineral slice reveals quartz in two different forms – as a base layer of cryptocrystalline agate, and the upper layer of rock crystal upon which the former rests.

Agate geode | This geode – a mineral infilling an air bubble left in flowing lava after cooling – was first lined with agate, then later overgrown by tiny quartz crystals.

Amethyst crystals | These crystals show pyramid-shaped terminations. They are a section of a massive, amethyst-lined geode, some of which can be several feet across.

Amethyst geode | This superb amethyst geode shows delicate layers of first-formed agate, and the later layers of fine amethyst crystals, topped with a brown calcite group.

Aventurine rough | Dotted with tiny scales of mica or hematite, the quartz variety crystalline aventurine comes in various colours, and is popular for cabochons or tumbled stones.

Smoky quartz | This beautifully crystallized, double-terminated smoky quartz rests in a groundmass of milky quartz. Black quartz is sometimes known as morion.

Milky quartz | Long disregarded for its lack of clarity, translucent to opaque milky quartz has, in recent years, become highly valued by gem cutters and New Age collectors.

Namibian quartz | Quartz specimens from different localities all bear the same characteristic internal structure. This piece originates from Namibia.

Rose quartz crystals | Crystals of rose quartz are exceedingly rare. Here, a group of crystals up to 1cm (½in) in length surmount massive rose quartz.

Cat's eye quartz rough | The parallel needles of another mineral that create the "eye" when cut *en cabochon* can be seen in this piece of cat's eye quartz rough.

Rock crystal | This stunning group of perfectly formed quartz rock crystals originates from the state of Arkansas, USA. It is large at 13cm (5in) in height and also features a base of tiny quartz crystals.

Natural citrine | Much of the "citrine" quartz variety in the marketplace today is heat-treated amethyst. This Brazilian crystal is totally natural, and shows some water wear.

Hawk's eye rough | Hawk's eye is the mineral crocidolite saturated with quartz. In this variety the crocidolite is not oxidized; the oxidized variety is known as tiger's eye.

Rutilated quartz | This quartz crystal is shot through with needle-like crystals of the titanium mineral rutile. Quartz can also have black-to-green needles of tourmaline.

Rock crystal rough | This well-formed crystal is internally flawless, and is suitable for cutting into gems, carving, or being sliced into oscillator plates for electronics.

Cut and colour

Amethyst mixed cut | This hexagonal gemstone has an unusual mixed cut consisting of a faceted pavilion and a cabochon-domed crown.

Step cut | The faceter of this square, step-cut, internally flawless amethyst has cleverly given a slight rounding to the corners to prevent chipping.

Mixed cut | This mixed-cut oval amethyst, with a brilliant cut crown and a step-cut pavilion, was cut with many tiny faces to disguise any colour variation within.

Milky quartz | Milky quartz is rarely faceted, but this intricate, brilliant oval cut adds an air of haunting mystery to the cloudy interior of the stone.

Fancy free-form amethyst | Cuts such as this 40.3-carat amethyst are known as "free-form" cuts: that is, the placement of the facets does not follow standard patterns.

Rock crystal | Faceted rock crystals were the original "rhinestones" – from quartz found in the Rhine. This brilliant cushion cut shows the "steeliness" of some stones.

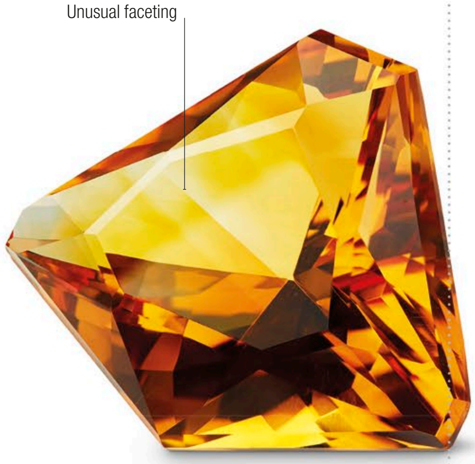
Rose quartz | Facet-grade rose quartz is fairly uncommon; the detail of this briolette cut enhances the exceptional quality of the material, which is usually cloudy.

Amethyst in myth

Origins and superstitions

According to myth, amethyst was created by Bacchus, the Greek god of intoxication, wine, and grapes. He was pursuing a woman, Amethyste, who refused his affections and prayed to the gods to remain chaste. The goddess Diana responded, transforming Amethyste into a white stone. In shame, Bacchus poured a goblet of wine over the stone as an offering, dyeing its crystals purple. In Greek legend, amethyst is also said to ward off drunkenness, while medieval European soldiers wore it into battle, believing it had healing properties. The "blasted" Heron-Allen amethyst (right), meanwhile, is famously cursed.

Heron-Allen amethyst
This stone was said to bring misfortune to all who touched it.

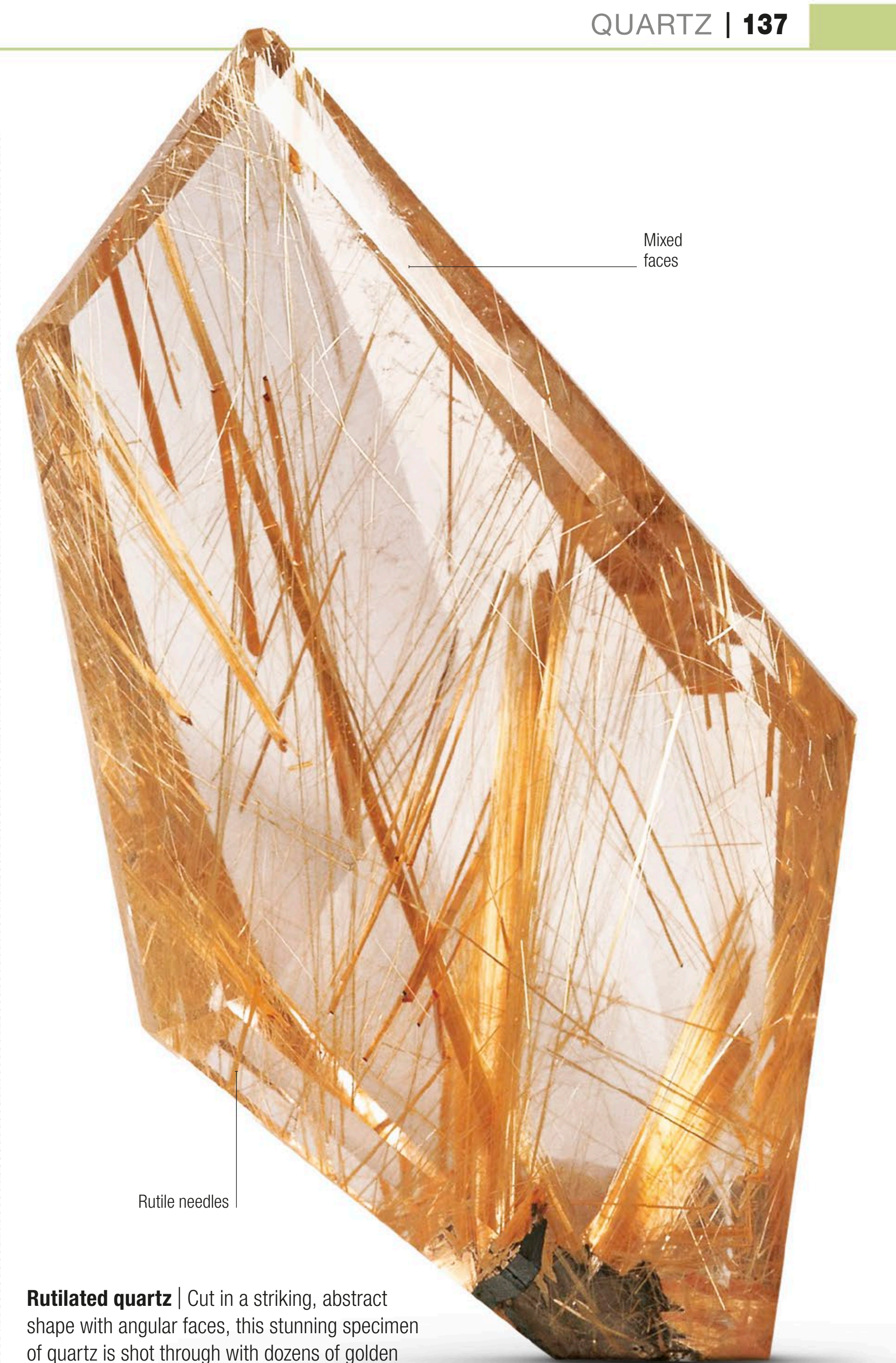


Free-form citrine | The cut on this spectacular 60.29-carat citrine is classed as free-form rather than fancy, in that it has facets placed at all angles and positions.

Pendaloque cut | The cutter of this splendidly coloured citrine pendaloque has created a large table facet to expose more of the interior colour.

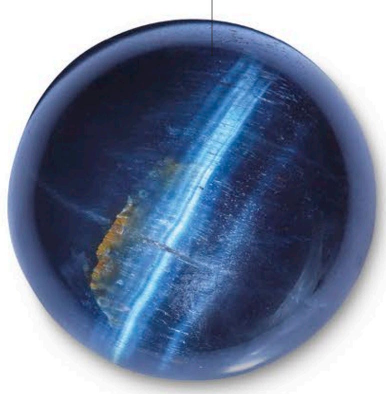
Cushion cut | This fancy cut cleverly combines a mixture of small and large faces to refract light and lighten the interior of this smoky quartz.

Brown smoky quartz | This gem is one of a pair of briolette-cut gems intended as earring drops. It is a perfect example of this type of gem cut.



Rutilated quartz | Cut in a striking, abstract shape with angular faces, this stunning specimen of quartz is shot through with dozens of golden needles of the titanium mineral rutile.

Rose quartz | Facet-grade rose quartz is somewhat cloudy: this 16.34-carat rectangular cushion cut uses large facets to emphasize colour rather than brilliance.



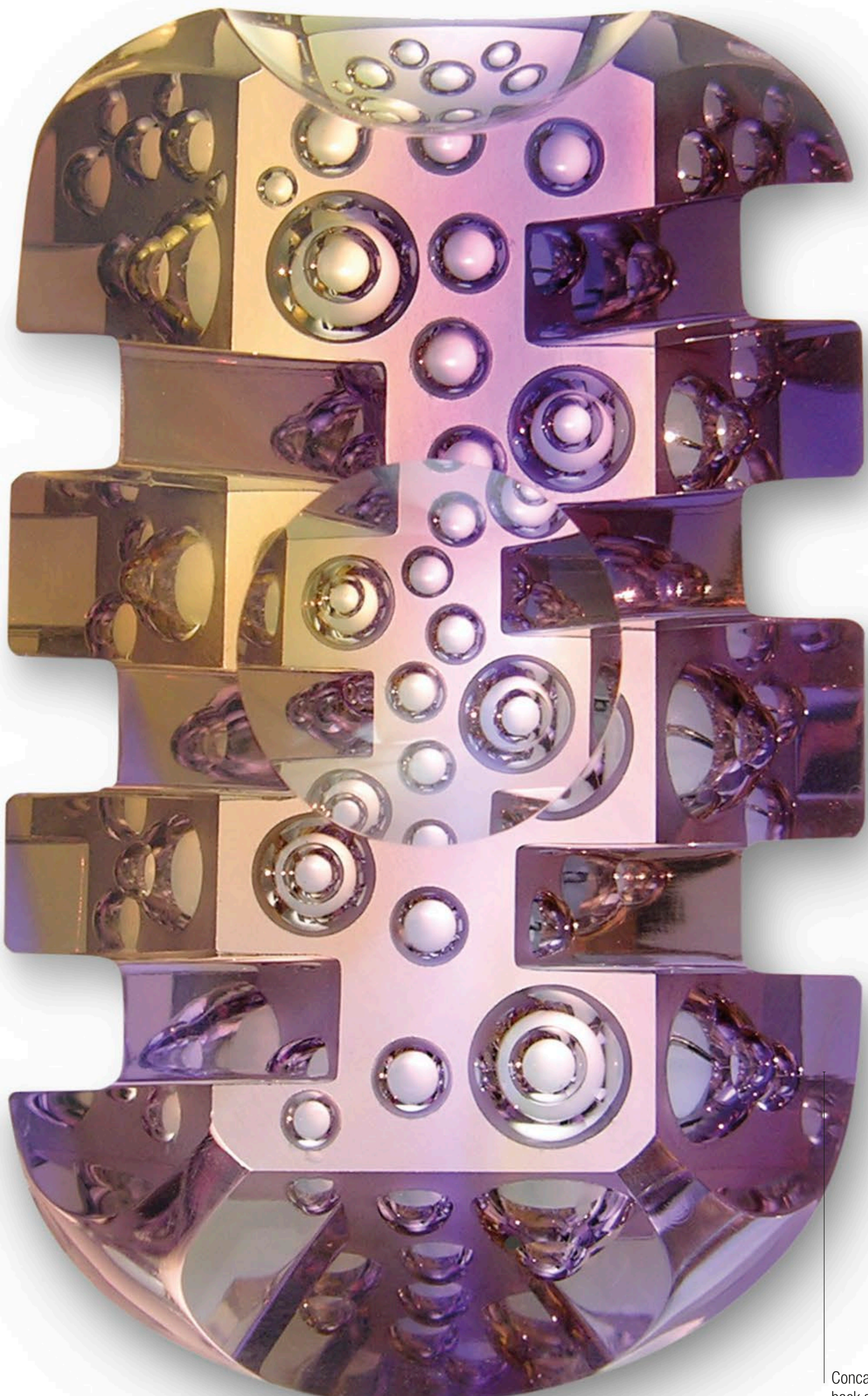
Hawk’s eye quartz | The rich blue colour in hawk’s eye quartz comes from numerous parallel fibres of the mineral crocidolite enclosed within it.

Tiger’s eye quartz | Tiger’s eye quartz contains crocidolite fibres exactly as in blue hawk’s eye, but in tiger’s eye they are oxidized to a golden colour.

Cat’s eye quartz | In cat’s eye quartz the “eye” isn’t as sharp as in other minerals, but when cut in a high-domed cabochon, as here, it is still prominent.

Settings

Ametrine ultramodern | This cut ametrine typifies a new trend in gem cutting, combining faceting and carving to create optical illusions and unusual forms.



Roman cameo | In ancient Rome, the Hellenistic fashion of cameos continued. This 1st–2nd-century CE amethyst cameo features the head of a Roman empress.

Art-Nouveau brooch | Made by German craftsman Theodor Fahrner around 1910, this brooch consists of silver leaf patterns framing an emerald-cut amethyst.

Amethyst and seed pearl brooch | Set in gold and with a flower-and-leaf motif, this brooch's "petals" are faceted amethysts with seed pearl centres.

Rose-bloom fell on her hands together prest, And on her silver cross soft amethyst

John **Keats**
Romantic Poet

Rock crystal pendant | This rock crystal heart-shaped pendant, suspended from a gold and blue enamel bow, originates from the 19th century.

Rock crystal brooch | In the 19th century, gold brooches such as this with rock crystal "windows" were commonly used to store a lock of a loved one's hair.

Rock crystal ring | In this white gold ring, a dazzling lozenge-shaped, fancy-cut rock crystal gemstone has been cleverly set to protect its sharp points from chipping.

Faceted egg | This full-size rock crystal egg has been faceted with hundreds of perfectly meeting facets in a display of the highest gem-cutting skill.

Rock crystal brooch | Made in 1972 in Birmingham, UK, this 18-karat gold, sapphire, and rock crystal brooch features an unusual abstract design.

Tourmalated quartz | The material from which this extremely fine Chinese snuff bottle is carved is rock crystal with hundreds of tourmaline needles within it.

Citrine and amethyst | The oval-cut citrine gemstone in the centre of this ornate brooch is surrounded by gold leaves and brilliant-cut amethysts.

Crystal skulls

Ancient mystery or hoax?

In modern culture, skulls cut from quartz have become popular for their alleged mystic qualities. Supposedly ancient Mesoamerican artefacts, none of the examples submitted for scientific testing have so far been authenticated as pre-Columbian. All have shown the marks of 19th-century tools; all are made from a type of quartz found in Madagascar; and many of them also seem to have passed through the hands of the same 19th-century antiques dealer, Eugène Boban.

Carved skull This artefact is made from rock crystal and measures 25cm (10in) in height.

The Royal Household at Delhi on the Occasion of the Birthday of the Grand Mogul Aurangzeb | c.1701–08 | 58 x 142 x 114cm (22 x 56 x 45in) | Gold, silver, enamel, various gems, and lacquer

Treasure chambers of Augustus II

△ **Order of the Polish White Eagle** from the collection

The Grünes Gewölbe (Green Vault) in the Residenzschloss in Dresden, Germany, is home to the largest collection of treasures in Europe. Founded in 1730 by Augustus II (1670–1733) to hold the royal jewel collection, it contains over 3,000 unique treasures. Augustus the Strong, as he was known, opened the doors of the Baroque rooms to the public, thus creating Europe's first public museum.

Elephant with howdah showing the fine detail from the Aurangzeb model

Among the featured exhibits is the extraordinary tableau of "The Royal Household at Delhi on the Occasion of the Birthday of the Grand Mogul Aurangzeb". The miniature model features the seventh Mughal Emperor of Hindustan, Emperor Aurangzeb (1658–1707), seated under a canopy and surrounded by 137 enamelled figures of men, animals, and objects of gold, ivory, silver, and jewels. The model originally comprised 5,223 diamonds, 189 rubies, 175 emeralds, 53 pearls, two cameos, and a sapphire – today, 391 precious stones and pearls are missing. The piece was created by one of Europe's greatest goldsmiths, Johann Melchior Dinglinger, c.1701–08. He was not commissioned to create the piece, but Augustus, who was delighted with the fabulous details, eventually paid him more than he spent constructing his castle at Moritzburg.

The piece embodies European society's fascination with Indian palaces and their riches. The wealth and power of the Mughal Empire reached its zenith under Aurangzeb; in the model he is depicted receiving 32 birthday gifts from the Empire's most powerful princes. These reference some of Dinglinger's other works, along with ancient Egyptian, Chinese, Greek, and Germanic objects and symbols, the significance of which was detailed in an accompanying treatise.

Photograph showing the devastation of Dresden in 1945. The treasures had been moved on the brink of World War II, thus surviving the Allied bombing of the city.

Death drops the curtain even on Emperors

Emperor **Aurangzeb**

Key dates

1658–1959

1650

- **1658** Aurangzeb becomes the seventh Mughal emperor
- **1694** Known as "the Strong", "Saxon Hercules", and "Iron Hand", Augustus II begins his reign
- **1698** Augustus II appoints Johann Melchior Dinglinger as court jeweller

1700

- **1701–08** Johann Dinglinger and brothers create the Aurangzeb tableau
- **1723** The Grünes Gewölbe in Dresden is founded by Augustus II
- **1723–30** Augustus II creates a Baroque chamber for the treasures at Grünes Gewölbe, including the Aurangzeb model

1725

1750

Augustus II, King of Saxony

1900

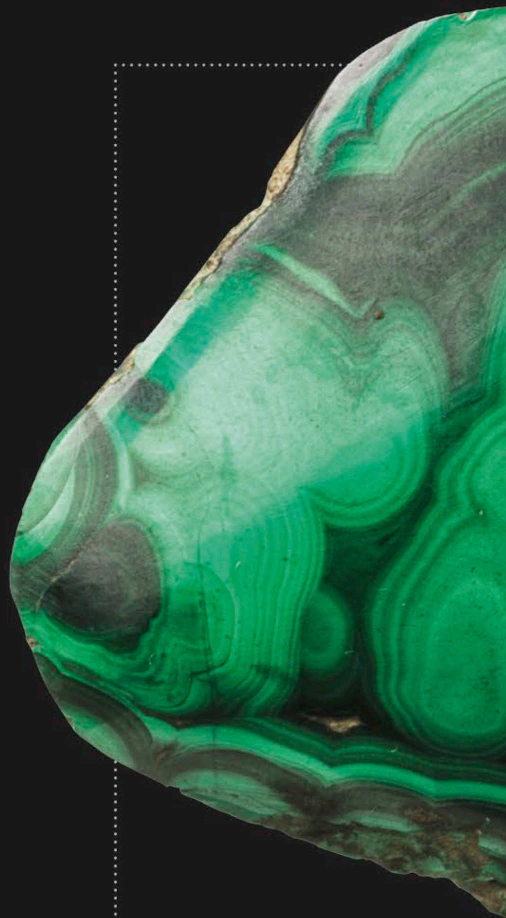
1925

- **1930s** Artworks from the Grünes Gewölbe are evacuated to Konigstein Fortress outside Dresden
- **1945** The surviving treasures are looted by the Soviet Red Army
- **13 February, 1945** Along with most of the city, the Grünes Gewölbe is almost completely destroyed in the firebombing of Dresden

1950

- **1958** The Soviet government returns the pieces to Dresden
- **1959** Parts of the collection are put on display in the Albertinum modern art museum in Dresden

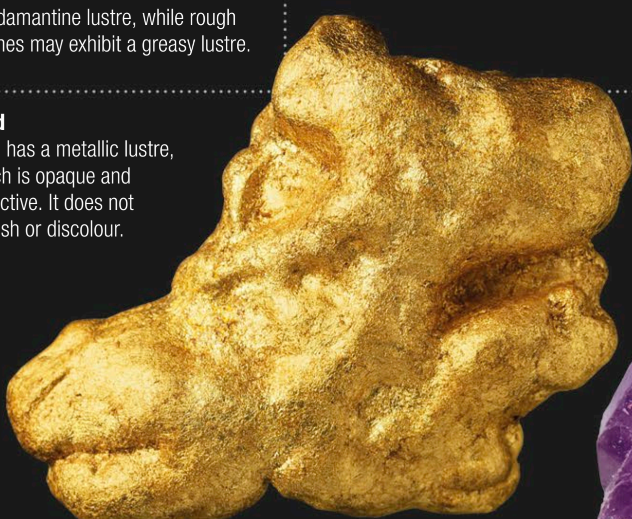
1975



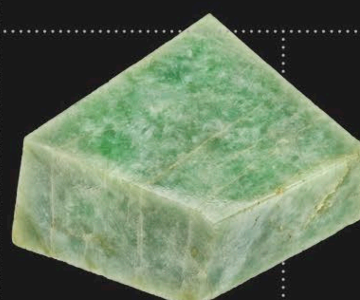
Surface lustre

Most gems have a vitreous lustre – their surface reflects light like glass. A few are metallic or adamantine (like a diamond). More rarely, gems may glimmer like silk or look matt, not shiny. Some feel greasy or waxy to the touch, while organic gems may be resinous or pearly. Lustre is subjective – judged by sight or touch rather than scientific criteria.

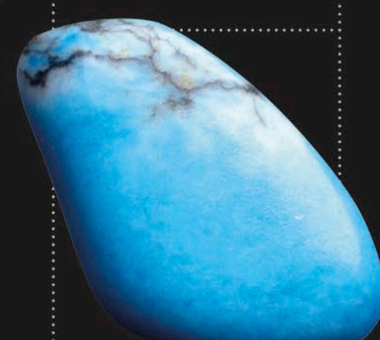
Diamond
Polished stones have an adamantine lustre, while rough stones may exhibit a greasy lustre.



Gold
Gold has a metallic lustre, which is opaque and reflective. It does not tarnish or discolour.



Jadeite
Jadeite has a greasy or oily lustre, which can occur if a mineral has a huge number of microscopic inclusions.



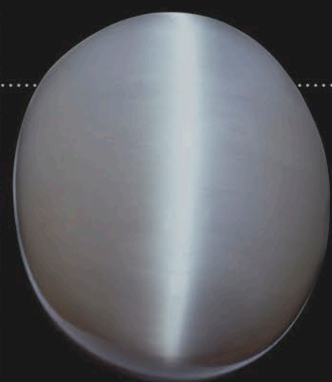
Tsavorite garnet
An extremely rare gem, tsavorite has a vitreous lustre, bordering on adamantine.

Citrine
A form of crystalline quartz, citrine displays a classic vitreous lustre.

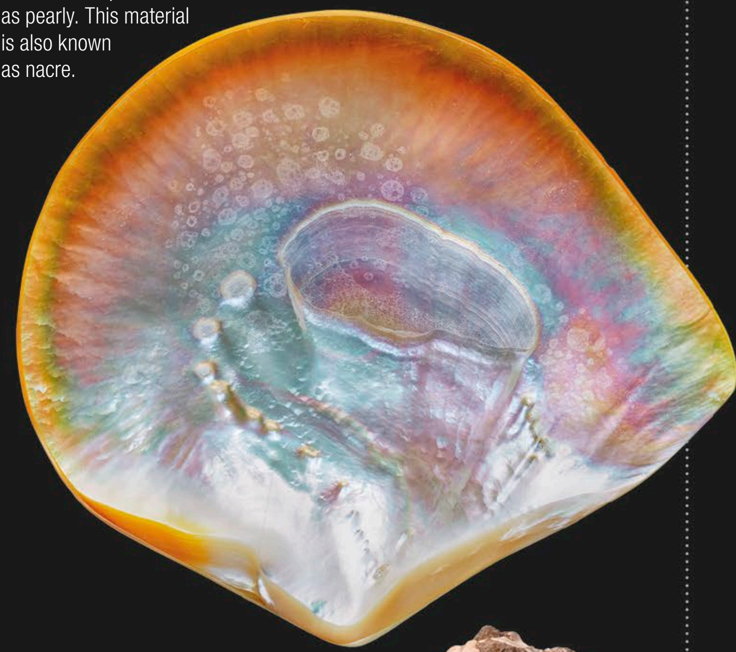
Amethyst
In common with most other silicates, amethyst has a vitreous lustre.

Howlite
Howlite has a subvitreous lustre – not quite or only partly vitreous.

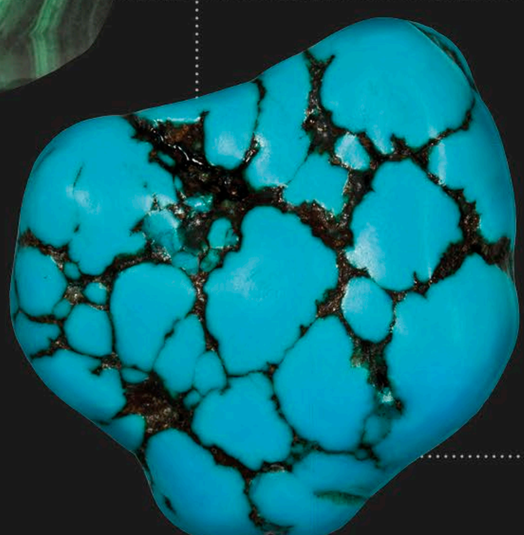
Malachite
Malachite material features a lustre that is defined as adamantine to silky.



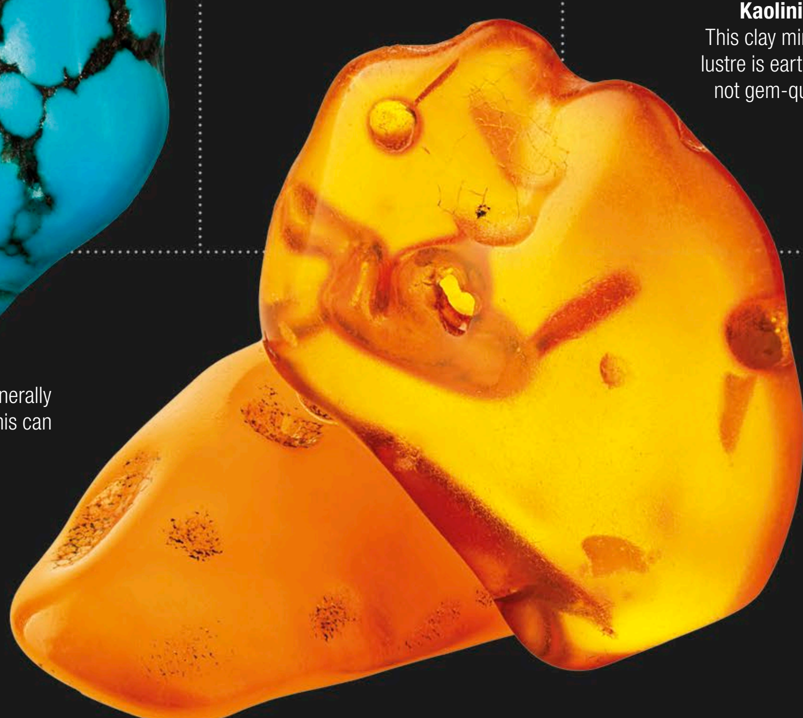
Satin spar
Satin spar normally displays a silky lustre, which is caused by microscopic inclusions.



Mother-of-pearl
Not surprisingly, the lustre of mother-of-pearl is defined as pearly. This material is also known as nacre.



Turquoise
The surface of turquoise generally has a waxy lustre, though this can range to subvitreous.



Amber
Amber has a resinous lustre, resembling the smooth surface of plastic. It is an organic gem, formed from tree resin.

Kaolinite
This clay mineral's lustre is earthy. It is not gem-quality.

All that glisters is not gold

William **Shakespeare**
The Merchant of Venice

St George statuette | 1586–97 | 50cm (20in) tall | Gold, silver-gilt, diamonds, rubies, emeralds, opals, agate, chalcedony, rock crystal and other precious stones, pearls, and enamel

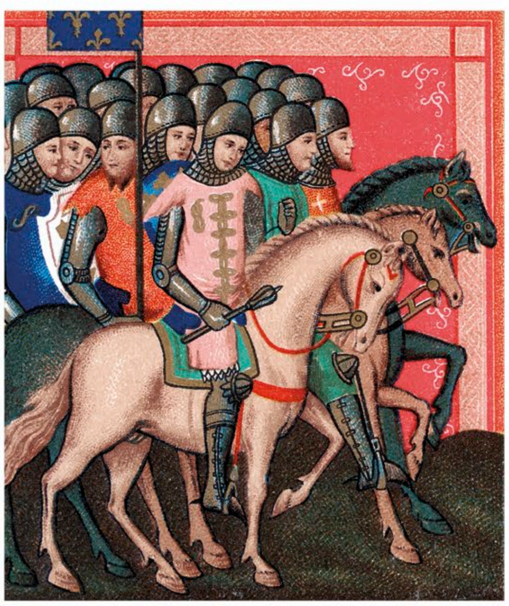
St George statuette

△ **St George** slaying the dragon in an early 16th-century painting by Raphael

This dazzling reliquary features a statuette of England's patron saint, St George, astride his horse, trampling underfoot the dragon he is famous for slaying. The horse is chalcedony, clad with a jewel-encrusted enamel caparison and crested with rubies and pearls. The dragon, scaled with emeralds and ruby-studded, has a white enamel belly. St George's armour is minutely detailed and the helmet's visor may even be lifted to reveal his face, which resembles the work's commissioner, Duke Wilhelm V of Bavaria. The gold pedestal that supports knight, horse, and dragon is richly adorned with diamonds, rubies, emeralds, pearls, agate, opals, and other gems. A drawer decorated with the Bavarian coat of arms in sapphire and enamel contains the relics of St George.

St Alexandra – martyr, Roman empress, and wife of Diocletian

The original legend of St George and the dragon was brought back from the East and adapted by the European Crusaders. Various versions of the story are told and, while they may be viewed as pure fiction or as an allegorical account of Christianity's triumph over paganism, it is recorded that St George himself was a historical figure. While serving as a soldier in the Roman army, he was tortured and executed after refusing the Emperor Diocletian's personal request to renounce his Christianity. Impressed by St George's faith, Diocletian's wife, the Empress Alexandra, converted to Christianity and was also executed. It is possible she is the origin of the "princess" the knight rescues in the legend. St George's tomb is located in Lydda, Palestine, and relics from his remains are preserved in holy sites all around the world.



A band of armed Crusaders embarking for the Holy Land, where the legend of St George originated, in an illuminated manuscript from the *Statutes of the Order of St Esprit*

It is not an impure idol, it is a pious memorial

Bernard of **Angers**
11th-century chronicler

Key dates

275 CE–2000s

200 CE

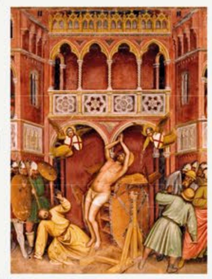
c.275–285 CE St George is born to a Greek noble family in Lydda (modern-day Palestine). He later joins the Emperor Diocletian's army at Nicomedia

300 CE

24 February, 303 CE Diocletian issues an edict declaring all Christian soldiers should be arrested. St George publicly rejects the emperor's edict

23 April, 303 CE St George is tortured on a wheel of swords and beheaded. He is soon after regarded as a martyr

400 CE



St George on the torture wheel

494 CE St George is canonized by Pope Gelasius

500 CE

1500

1586 Archbishop Ernst of Cologne (1554–1612) sends relics of St George to his brother Duke Wilhelm V of Bavaria (1548–1626), known as "the Pious"

1590 Duke Wilhelm commissions the statuette. Court goldsmith Hans von Schwanenburg of Utrecht designs it; Hans Schleich of Munich creates it

1600

1600s The statuette is displayed on important feast days on the altar of the Rich Chapel in the Munich Residence, Germany

1800

2000

2000s The reliquary remains in the Treasury of the Munich Residence

Snake bracelet | This stunning bracelet in 18-karat gold features flexible segments with blue enamel scales, ruby eyes, and a diamond-encrusted head with a chrysoprase cabochon.

Chalcedony drives away phantoms and visions of the night

Josephi **Gonnelli**
18th-century physician

Chalcedony

△ **Leaf-shaped** carnelian cabochon

Chalcedony is a compact variety of quartz, composed of crystals that are microscopic (microcrystalline) or too small even for a standard optical microscope (cryptocrystalline). It forms in cavities, cracks, and by replacement when low-temperature, silica-rich waters percolate through preexisting rocks, in particular volcanic rocks. It is relatively porous, and much chalcedony on the commercial market has been dyed to enhance or colour it artificially. Chalcedonies of all kinds have been used as gems, beads, carvings, and in seals for thousands of years. The earliest stone tools were generally made of some form of chalcedony.

Varieties

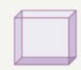
Pure chalcedony is white. However, when trace elements or microscopic inclusions of other minerals occur, it can yield a range of colours. Many of these have their own variety names: chalcedony that shows distinct banding is called agate; blood-red to reddish-orange translucent chalcedony coloured by inclusions of iron oxide is know as carnelian; bloodstone is dark, opaque green coloured by traces of iron silicates and with patches of bright red jasper. Chrysoprase is a translucent apple-green variety, coloured by nickel; sard is light to dark brown chalcedony, while sardonyx is colour-banded sard; jasper, chert, and flint are opaque, fine-grained or dense, impure varieties of cryptocrystalline quartz.

Specification

Chemical name Silicon dioxide | **Formula** SiO_2 | **Colours** All colours | **Structure** Hexagonal/trigonal | **Hardness** 7 **SG** 2.65 | **RI** 1.54–1.55 | **Lustre** Vitreous


Cabochon


Cameo


Slab

Locations
1 USA **2** Peru **3** Morocco **4** Scotland **5** Netherlands **6** Czech Republic **7** Poland **8** Madagascar **9** Sri Lanka **10** Myanmar **11** Russia

Key pieces

Ancient Egyptian gold pectoral | The lavish gold funerary pectoral of Pharaoh Psusennes I (3rd Pharaoh, 21st Dynasty), from around 1040–996 BCE, is decorated with inlays of red jasper and lapis lazuli.

Aztec knife | The blade of this highly decorated Aztec sacrificial knife is chipped from fine flint, with a mosaic handle of turquoise, coral, and jet. It is throught to originate from around the 15th to 16th centuries.

Chalcedony cup | Combining superb lapidary and enamelling work, this antique cup has been delicately carved from waxy grey chalcedony material and set with gold trimming. The enamel decoration is particularly fine on the handles.

Rough

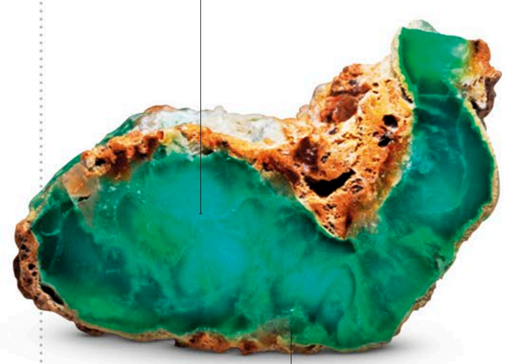
Red jasper | This variety of red jasper from Arizona, USA, shows colour mottling that will make colourful and interesting cabochons.

Gem rough | This fine piece of massive gem carnelian rough has good colour all the way through, and excellent translucency. It is naturally dyed with iron oxide.

Banded jasper | The dramatic colour banding in this example of jasper rough clearly shows why it has been a popular carving and gem material since antiquity.

Heliotrope rough | This specimen consists of heliotrope, a green variety of chalcedony shot through with red patches of iron oxide, for which it is also known as bloodstone.

Water agate | Originating from a single locality in Brazil, agates of this variety are actually hollow geodes filled with preserved water, revealed by grinding a “window” into the inside.



Chrysoprase | This gem chrysoprase specimen displays a beautiful deep green colour. Chrysoprase remains one of the most sought-after varieties of chalcedony.

Settings

Chalcedony ring | Unpatterned blue chalcedony is relatively uncommon, but comprises this subtle, pastel-blue cabochon set in a 14-karat yellow gold ring.

Chalcedony's name is thought to originate from the ancient port of Kalkedon in Asia Minor (modern Turkey)

Russian urn | Carved from a single piece of Ural Mountains jasper, this spectacular multicoloured urn demonstrates the finest in 19th-century lapidary skill and craftsmanship.

Pendant brooch | Bearing the signature E. Paltscho, this beautiful gold-mounted pendant brooch features carnelian leaves and an agate flower, highlighted by diamonds.

Giardinetto brooch | This fabulous giardinetto brooch features diamond and emerald accented flower heads carved from amethyst, chrysoprase, carnelian, turquoise, and coral.

Bloodstone watch case | The back of this open-face pocket watch case is carved from bloodstone, inlayed with 18-karat gold, and surrounded by seed pearls.

Silver pin | Based around four smoky chalcedony cabochons, this silver pin was designed by the influential Danish silversmith Georg Jensen.

Van Cleef & Arpels pendant | Adorned with cabochons of chrysoprase and lapis lazuli, this gold pendant is also set with diamonds in a rope motif.

Silver-gilt kovsh | This stunning kovsh (ceremonial drinking vessel) from Tsarist Russia features the finest in cloisonné enamel, and is highlighted by cabochons of chrysoprase and garnet. A kovsh of this quality would have been a royal gift.

Top view

Side view

Bottom view

Snuffbox | c.1765 | Carved chrysoprase, gold, gems, and foiled diamonds

Frederick the Great's snuffbox

△ **Detail showing tinted diamonds** in varicoloured gold setting

Frederick II "the Great" of Prussia (r.1740–86) loved snuffboxes, and his collection supposedly included one for each day of the year. He was also known for his liking of the green gemstone chrysoprase, and he commissioned eight snuffboxes made from the mineral. London-trained designer Jean Guillaume George Kruger is thought to have made this example in around 1765, and Frederick later presented it to his brother Augustus Wilhelm, Prince of Prussia, as a gift.

Jewelled mother-of-pearl snuffbox, commissioned by Frederick the Great

The oval box and its cover are both made from single pieces of chrysoprase, a green variety of chalcedony (see pp.146–49). Diamonds and other gems are mounted on varicoloured gold in the forms of scrolls, vines, and sprays of flowers; and pale pink, green, and lemon-yellow foil has been placed behind the diamonds to tint them subtly. The interior of the lid is bordered by gold and engraved with more flowers and scrolls.

Frederick was renowned for his military achievements, but also for his patronage of the arts. He was fond of fine materials, and among these he so favoured chrysoprase that towards the end of his life he had pieces of chrysoprase set out for him to look at alongside his boxes and jewels. His interest in elegant boxes was influenced by his mother Sophia-Dorothea's collection, and he kept a snuffbox on his person at all times. This proved fortuitous in 1759 at the Battle of Kunersdorf during the Seven Years' War, when he was hit by a Russian bullet – it was deflected by the snuffbox in his pocket, saving his life.

> **His approach to aesthetic quality… was robust**
>
> Tim **Blanning**
> Author, on Frederick the Great

Fredrick the Great of Prussia pictured at the Battle of Kunersdorf in 1759, where his snuffbox deflected a Russian bullet, and so saved his life

Key dates

1712–1786

1700

1712 Frederick II is born

1740 Frederick II takes the throne and conquers Silesia (now mostly in Poland), where chrysoprase is mined, in the First Silesian War

1750

1753 Jean Guillaume George Kruger, a London-trained designer, moves to Berlin and designs a series of snuffboxes for the Prussian royal collection

1755

1756 Frederick enters the Seven Years' War, which involves most of the world's major powers of the period

1759 During the Battle of Kunersdorf in the Seven Years' War, a snuffbox in Frederick's pocket saves him from a Russian bullet

1760

1763 The Seven Years' War ends, leaving Prussia a major power

c.1765 The chrysoprase snuffbox is created, probably by Kruger; Frederick presents it to his brother, Augustus Wilhelm

1770

Frederick's brother, Augustus Wilhelm

1780

1786 Frederick the Great dies

Agate

△ **Fire agate** with unusually fine colouring

The microcrystalline, compact variety of quartz, agate is a common, semiprecious chalcedony. Agate is mostly characterized by colour bands in a concentric form, and less often by moss-like inclusions, when it is called moss agate. Other names, such as fire, or Brazilian, often precede the word agate and these can describe the locality where they are found, or denote a particular appearance or coloration. Agates are almost always cut *en cabochon*, carved, or used as beads or ornaments.

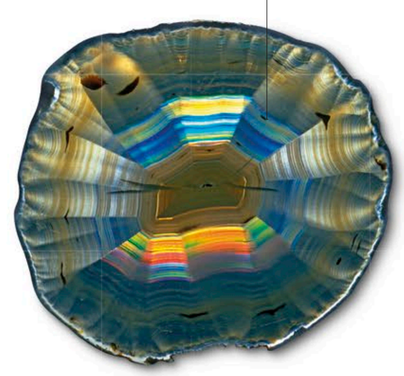
Specification

Chemical name Silicon dioxide | **Formula** SiO_2 **Colours** All **Structure** Trigonal | **Hardness** 7 | **SG** 2.6 | **RI** 1.53–1.54 **Lustre** Vitreous | **Streak** White | **Locations** Worldwide, notably Brazil, Botswana, South Africa, Egypt, Mexico, China, and Scotland; fire agate only in northern Mexico and southwestern USA

Rough

Agate slice | Seen here in cross-section, the bright and varied circles of colour displayed in this agate slice indicate that it began life as a nodule of layered carnelian, and was then overlain by multiple layers of varicoloured chalcedonies.

Brazilian agate | This slice shows stages of the agate's formation: the lava cavity was lined with crystallized quartz, then the inner hollow was layered with varicoloured chalcedony.



Iris agate slice | The chalcedony layers in this agate are extremely thin, and act as diffraction gratings to produce rainbow colours according to their thickness.

Agate rough | The surface of this specimen is botryoidal – it appears as a mass of globular forms, resembling a bunch of grapes. The layering typical of many types of agate is also visible.

Cut

Composite cameo | The layering of agate lends itself to cameo work. This example has a carved figure applied to a background of mossy agate.

Moss agate cabochon | The cabochon cut shows off the mineral inclusions, often chlorite, as here, which give the appearance of moss growing within the agate stone.

Settings

Agate bowl | The polished surface of this shallow bowl carved from moss agate shows the intricate appearance of the stone. The irregular form of the piece complements the natural, random pattern of the gem.

Colour

Dyed agate | Agate is relatively porous, and so it can easily be dyed. Blue, as here, is typical; red or purple are also common. It can be difficult to tell dyed agate from natural.

Fire agate cabochon | The cabochon cut of this fire agate stone brings out its natural iridescence. Its bubbling, oily appearance is caused by iron oxide inclusions.

Multicoloured necklace | This necklace combines spherical beads of a number of quartz minerals, including agate, rose quartz, and rock crystal.

Silver-mounted brooch | Typical of Celtic-style pieces produced from the 19th century, the agate used for this brooch was recovered from the beaches of northern Scotland.

In the Middle Ages, wearing agate was thought to cure insomnia and ensure sweet dreams

Moss agate | In this cabochon, the "moss" is in fact staining from one of the iron or manganese oxides that penetrated the agate after it was formed.

Types of agate

Lace and fire

Fire agate is an unusual variety that has iridescent rainbow colours, with brown to honey-coloured base material. Cutting is a meticulous process, removing only enough stone to reveal the "fire". Fortification agate is a general term for banded agate with angularly arranged bands. Brazilian agate is a fortification agate with banding in angled concentric circles, and Mexican lace agate – called "crazy-lace" – is a multicoloured fortification agate with convoluted layering.

Lace agate rough This uncut piece of Mexican lace agate shows the intricate swirls and folds typical of its patterning.

Onyx

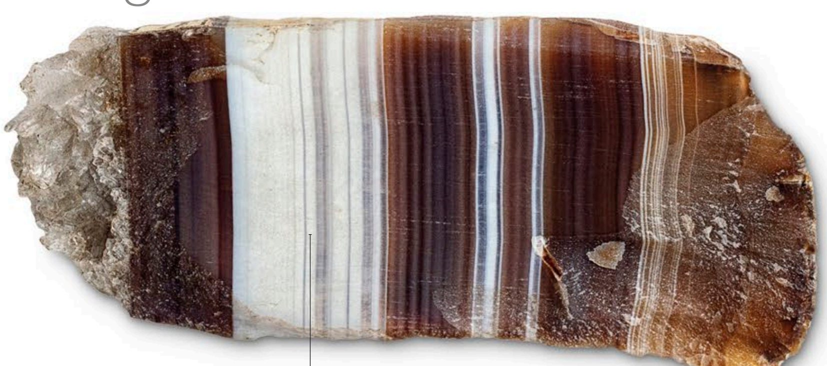
△ **Carnelian onyx cabochon** showing multiple layers of banding

Onyx is a striped, semi-precious variety of chalcedony quartz with alternating bands of black and white. Its varieties include carnelian onyx, which has white and red bands, and sardonyx, with white and brown bands; the name "onyx" is only properly applied to the black and white variety, but is also informally used for all varieties. Onyx is a popular material for cameos and intaglios because its layers can be cut to create a colour contrast. A quantity of the modern onyx on the market is produced artificially by dyeing pale, layered chalcedony.

Specification

Chemical name Silicon dioxide | **Formula** SiO_2 | **Colours** White colour-banded | **Structure** Trigonal | **Hardness** 7
SG 2.65 | **RI** 1.54–1.55 | **Lustre** Vitreous | **Streak** White
Locations India, South America (onyx); Sri Lanka, India, Brazil, Uruguay (sard and sardonyx)

Rough

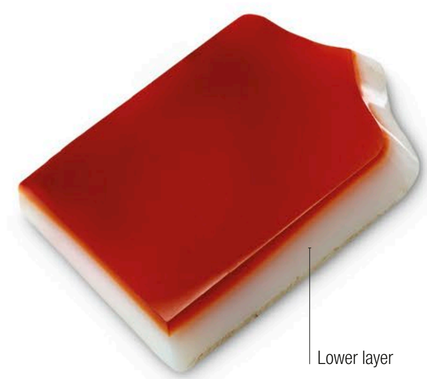


Onyx rough | This example is a fine-quality piece of onyx rough displaying multiple banding in several different colours, principally white, grey, brown, and purple. Colour layering such as this is highly desirable in onyx carving, and lends the characteristic layered appearance to cameos (see below).

Polished slab | This excellent quality slab of onyx features dramatic, characteristic colour banding, and could be shaped to create a superb cabochon.

Slab with light banding | Onyx does not always need bold contrasts to be desirable. The light-coloured banding seen here makes it excellent carving material.

Cut



Shield shape | This shield-shaped onyx cabochon could be carved into a cameo: the top layer would form the subject, with the bottom layer as the background.

Cabochon | The strong banding of onyx offers the lapidary a number of choices when cutting, as with this flat-topped cabochon showing clear contrast.

Roman cameos

Layers and contrast

The ancient Roman world produced some of the finest cameos ever made, and sardonyx in various colours and shades was the preferred medium. The intricacies of Roman carving and their use of the colour contrasts of the various layers remain unsurpassed. One unusually fine group of cameos, often referred to as the "State Cameos", were of the Emperor Augustus, and show him with various divine attributes. One of the most stunning is the Blancas Cameo, now in the British Museum.

Roman cameo Onyx was a favourite medium for Roman cameo carvers – this one depicts an empress.

Settings

Onyx brooch | This stunning brooch combines a circle of black onyx set with diamonds with two platinum and pink coral side-bars set with diamonds.

Dragon Mystérieux watch | Designed as a stylized dragon, this Cartier watch features 18-karat white gold, fire opal, diamonds, coral, and emeralds framing an onyx dial.

Georgian seal | The handle of this Georgian seal is intricately carved in onyx with the colour banding showing high contrast: it is a fine example of Georgian lapidary work.

Onyx ring | Here a platinum ring is set with triangular stones of black onyx, with a large central diamond and cross-bars set with numerous small diamonds.

Gold and onyx pendant | This gold pendant is set with a multi-layered onyx engraving with a monogram cut into the second layer. The red background gives the top layer a pink hue.

Sardonyx cameo | This cameo of a classical figure cut into multi-layered sardonyx is a masterpiece of the carver's art. The colour banding creates shading on the figure.

Onyx and diamond pendant | This gold pendant claw-mounts an unusual black onyx stone, surrounded by a lavish setting of 21 diamonds.

> **The onyx, if worn on the neck, was said to cool the ardors of love**
>
> George Frederick **Kunz**
> Mineralogist

GOLD AND POWER

The goldsmiths and jewellers of Italy were innovators during the Renaissance, elevating their craft to that of art under the patronage of the powerful de' Medici family, a banking and political dynasty that was established by Cosimo the Elder and effectively ruled Florence from the 15th to the early 18th centuries. The goldsmith's trade incorporated painting and sculpture, and many of the great Renaissance artists emerged from the Medici workshops, including Filippo Brunelleschi, Sandro Botticelli, and Benvenuto Cellini. Francesco I de' Medici, son of Cosimo I and Grand Duke of Tuscany, was especially interested in metalwork and jewellery. He established a workshop in the Uffizi Palace to broaden and develop jewellery-making techniques and the artistry of its practitioners.

Not suprisingly, the Medici crown jewels were renowned throughout Europe. Included in the trousseau of Catherine de' Medici for her marriage to King Henry II of France were pear-shaped pearls among the largest in Europe and a casket inset with engraved rock crystal by gem-cutter Valerio Belli, whose patron was Giovanni de' Medici, the Renaissance Pope Leo X.

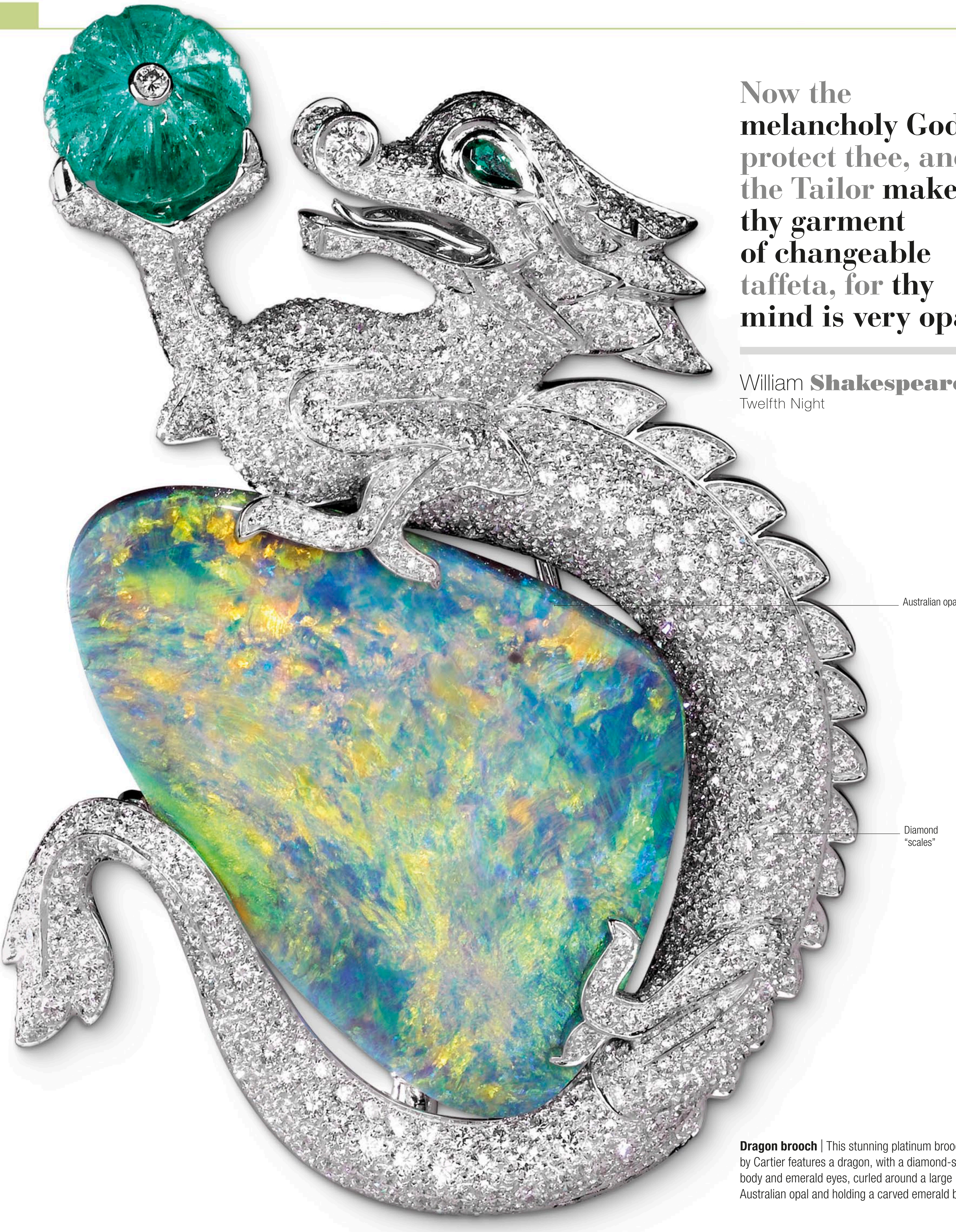
Gold is a treasure, and he who possesses it does all he wishes to in this world

Christopher **Columbus**
15th-century explorer

The Goldsmiths' Workshop, Alessandro (Il Barbiere) Fei, 1572
Grand Duke of Tuscany and patron of the arts Francesco I de' Medici (far left) inspects his father's crown and other items in a Florentine jewellery workshop.

Now the **melancholy God** protect thee, and the Tailor **make thy garment of changeable** taffeta, for **thy mind is very opal**

William **Shakespeare**
Twelfth Night



Dragon brooch | This stunning platinum brooch by Cartier features a dragon, with a diamond-set body and emerald eyes, curled around a large Australian opal and holding a carved emerald ball.

Opal

△ **Ethiopian opal** displaying a light-base, full spectrum play-of-colour

Opal falls into two categories: precious and common. The former displays highly prized rainbow iridescence with a white to dark body colour, while the latter has a strong, attractive body colour and no iridescence. Both kinds consist of hardened silica gel, and usually contain 5–10 per cent water in submicroscopic pores. Precious opal consists of a regular arrangement of tiny, transparent, silica spheres, and its colour play occurs when the spheres are regularly arranged and of the correct size, causing the diffraction of light and its consequent break-up into the colours of the spectrum: the actual colours that appear depend on the size of the spheres. Opal is deposited at low temperatures from silica-bearing waters, usually in sedimentary rocks. In ancient times, the primary source was in present-day Slovakia; more recently, Australia was the chief producer, and is also the source of fossil bones and seashells that have been replaced by precious opal. Ethiopia is now the main source of gem opal.

Common opal

Mineralogically, common opal refers to fire opals, which are transparent to translucent and do not usually show a play of colour; it can also refer to opals with no colour or transparency and no gemstone value. Fire opals, sometimes called jelly opals, are prized for their rich colours: yellow, orange, orange-yellow, or red. Transparent fire opals tend to be faceted, and are often set into moderately expensive silver jewellery.

Specification

Chemical name Hydrous silicon dioxide | **Formula** $SiO_2.nH_2O$
Colours Colourless, white, yellow, orange, rose-red, black, dark blue | **Structure** Amorphous | **Hardness** 5–6 | **SG** 1.9–2.5 | **RI** 1.37–1.52 | **Lustre** Vitreous | **Streak** White

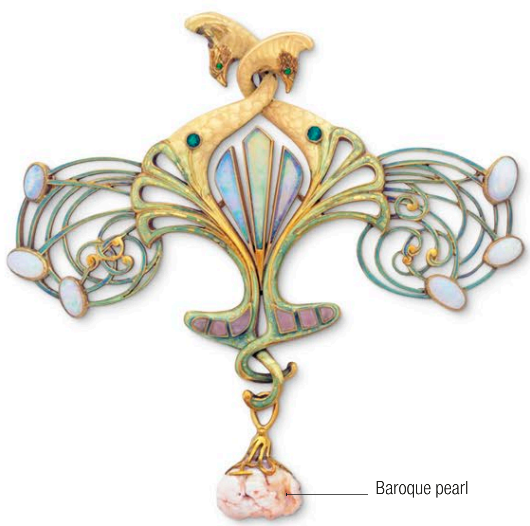

Round brilliant


Cabochon

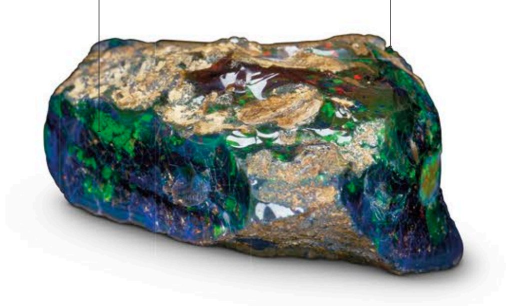
Locations
1 USA **2** Mexico **3** Honduras **4** Ethiopia **5** India
6 Australia **7** New Zealand

Key pieces

19th-century bracelet | Originating from Jaipur in India, this intricate gold bracelet is inlaid with fire opals, turquoises, and other precious and semi-precious stones. It also features enamelled decorative panels.



Peacock brooch | Designed by French jeweller Georges Fouquet, this gold brooch from around 1900 is decorated with opals, garnets, pearls, and enamel. Its delicate, almost organic form is typically Art Nouveau in style.



The Roebling Opal | Found in Virgin Valley, Nevada, USA, this huge, 2,585-carat piece of black opal rough exhibits vivid blue and green flashes of colour. Civil engineer John A. Roebling donated it to the Smithsonian's gem gallery in 1926.

Rough

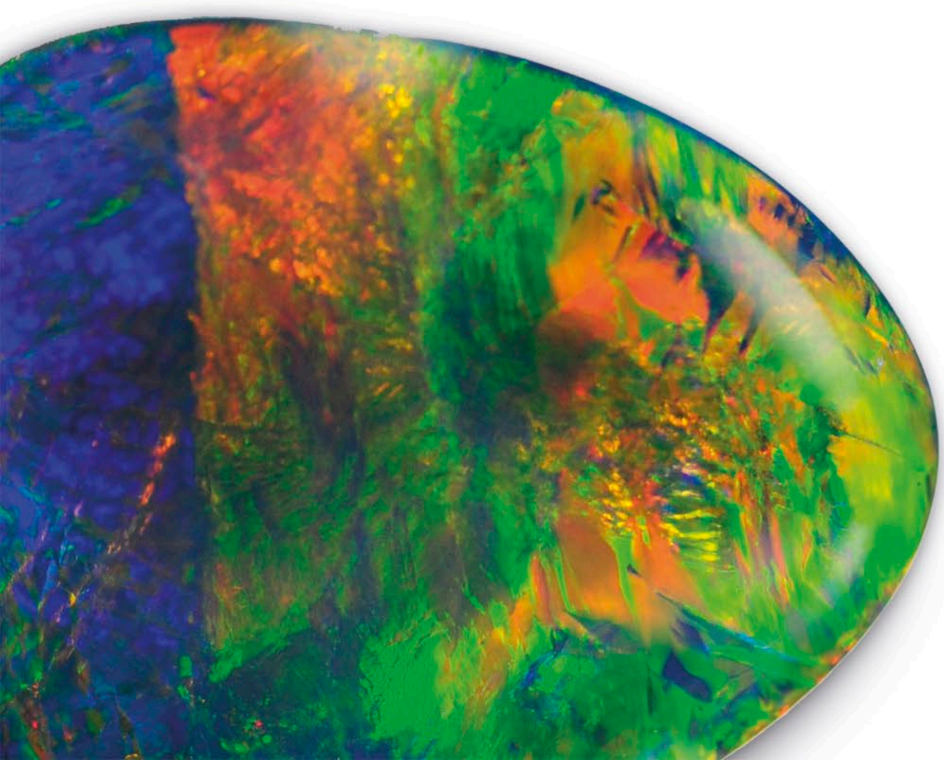
Common opal | The majority of opal is "common" opal – material that has neither transparency or fire. Here, pink common opal is in a rock groundmass.

Opal nodule | Much Australian precious opal is found in nodules, occasionally replacing fossils. This white-base nodule is from Coober Pede, Australia.

Opal in ironstone | Some Australian precious opal has formed simultaneously with ironstone and is interlayered with it, as in this specimen.

Fire opal | Opal that is transparent or translucent red or orange is called "fire" opal. This rough specimen has a fine deep colouring.

Ironstone matrix | This specimen represents a colourful example of Australian opal. It has developed in an ironstone matrix and consists of a mixture of precious opal and yellow common opal, or "potch" opal.



"Island Sunset" opal | This stunning black opal weighs 28.10 carats and was found at Lightning Ridge, Australia (see pp.162–63). It has been cut into a wide drop shape.

Cut

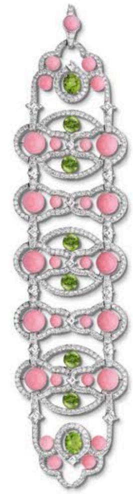
Boulder opal | This cabochon has been cut from small layers of opal intermixed with ironstone matrix. This mixture is known as "boulder" opal.

Faceted opal | Some fire opal (sometimes called "jelly" opal) is transparent enough to facet. This orange brilliant cushion is cut from Mexican fire opal.

Ethiopian opal | In recent years, a new discovery in Ethiopia has produced notable amounts of precious opal, as seen in this freeform cabochon.

Settings

Known since antiquity, opal derives its name from the Latin word "opalus", meaning "precious stone"



Pink opal bracelet | Created by Van Cleef & Arpels, this delicate bracelet is set with 29 cabochons of pink opal from the Wello region of Ethiopia.

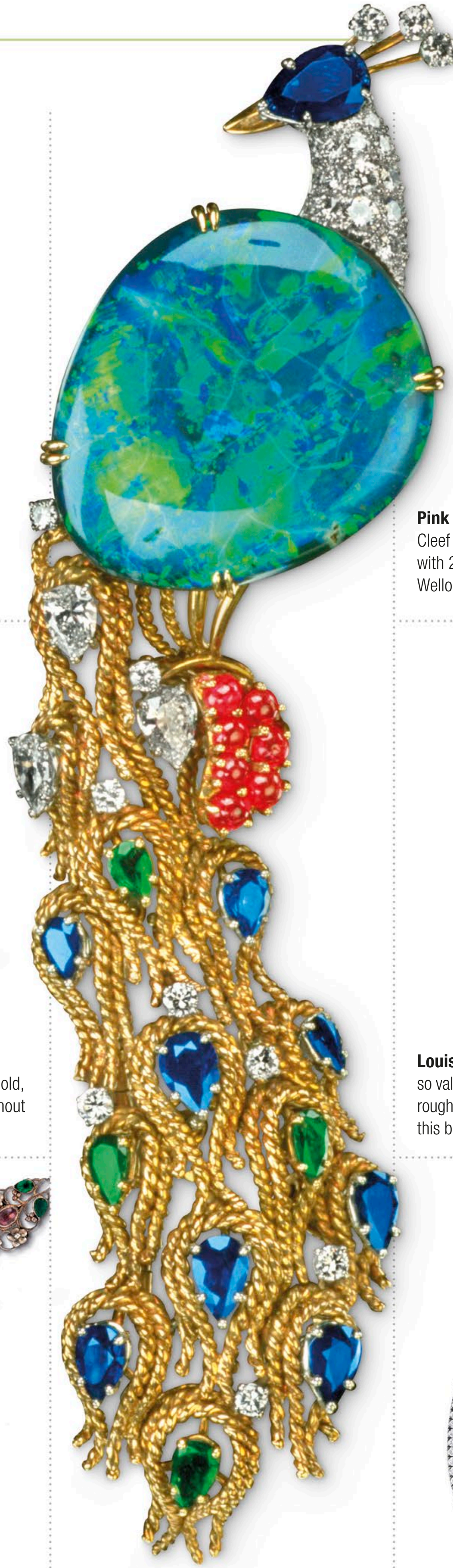
Opal and garnet ring | Based around a 4.18-carat opal cabochon, this intricate ring is also set with various garnets as beads or carvings, and brilliant-cut diamonds.

Pink opal ring | This playful Cartier ring features pink opal set into 18-karat pink gold, with a diamond. Its motif reoccurs throughout the Amulette de Cartier range.

Louis Comfort Tiffany opal | Some opal is so valuable it is cut in a shape to match the rough to avoid waste. Such is the case with this black opal with its irregularly-shaped cut.

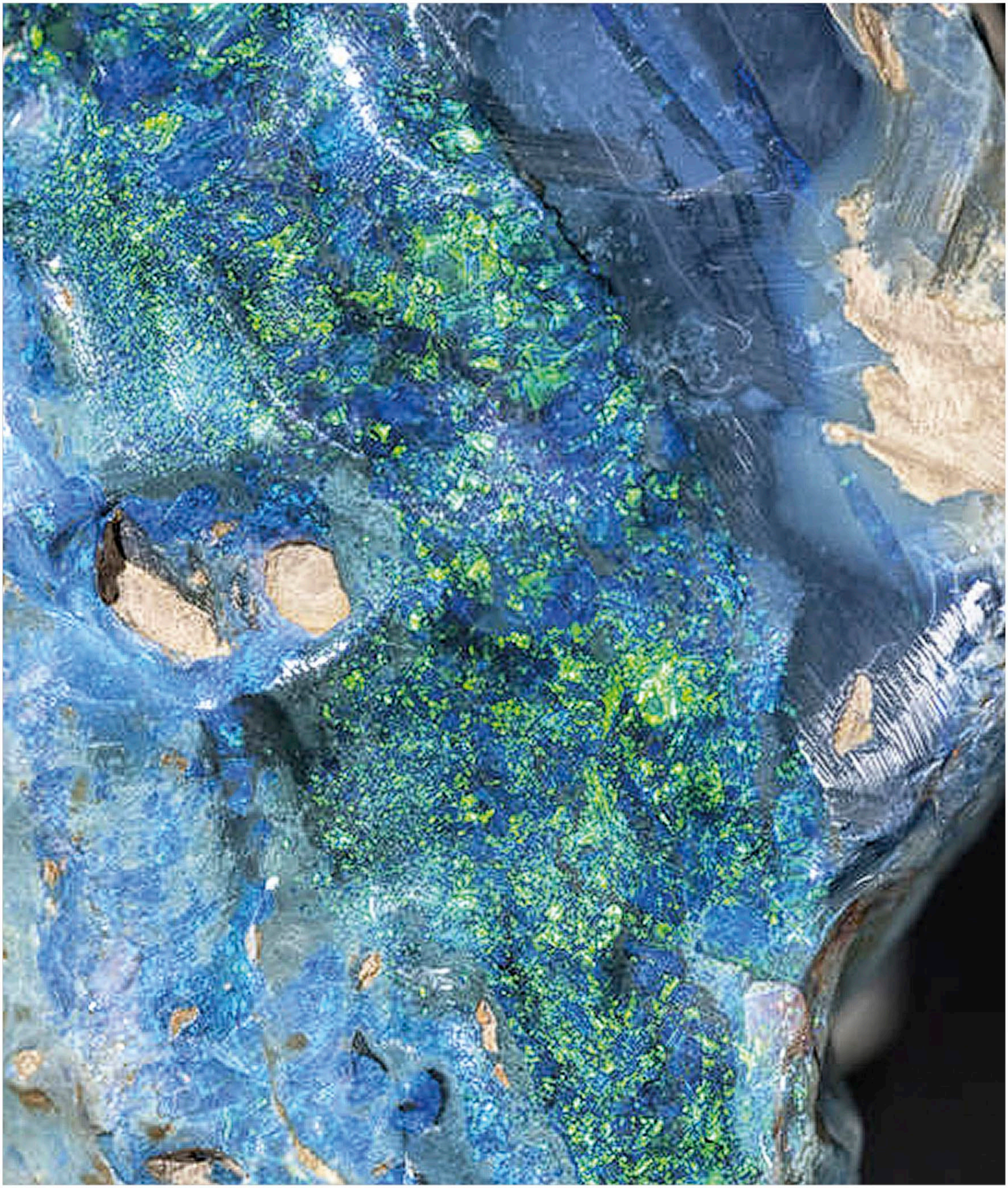
Opal earrings | In these gold earrings, a pair of double-domed fire opals are surrounded by foliate wreaths set with diamonds, with diamond-set suspensors.

Arts and Crafts necklace | With blue opal cabochons, emeralds, and pink tourmalines, this necklace was made by Georgie and Arthur Gaskin in the early 20th century.



Opal peacock brooch | This Harry Winston brooch features a 32-carat black opal from Lightning Ridge, Australia, set with sapphires, rubies, emeralds, and diamonds.

Doublet earrings | These modern earrings consist of four opals surrounded by 1.82 carats of diamonds, set in 18-karat white gold.



Halley's Comet opal | Discovered 1986 | 1,982.5 carats

Halley's Comet opal

△ **Full view** of the Halley's Comet opal

According to *Guinness World Records*, this impressive rock, which is roughly the size of a man's clenched fist, is the largest uncut black opal in the world. It was found in November 1986 by a group of five Australian miners known as "the Lunatic Hill Syndicate". They named it after the comet that was passing through the southern skies at the time of their discovery, which is only visible from Earth every 75 years.

Halley's Comet opal at auction, Bonhams, Los Angeles, USA

This nodule, or "nobby", was found at an open-cut mine near the outback town of Lightning Ridge in New South Wales, which boasts the largest deposits of black opal on the planet. The syndicate consisted of two brothers and a small company, which provided financial backing as well as the earth-moving equipment. They operated at the Leaning Tree Claim on Lunatic Hill. The hill's curious nickname dates back to the early days of mining on the site. Most experienced prospectors worked on the shallow flats below it, making their finds just a few feet below the surface. Only a madman would start at the top of the hill, they joked, as he would need to dig a very long way before discovering anything. Nevertheless, a lone miner tried it and his claim proved to be the most successful of all. The syndicate's efforts certainly vindicated their adoption of this painstaking approach, as the Halley's Comet opal was eventually located at a depth of 20m (66ft) below the surface.

Opals hold a special place in the Australian psyche. It is the country's national gemstone and it features in many legends that predate the arrival of European settlers. Aboriginal mythology relates how, in the Dreamtime, the Creator came down to earth on a rainbow, bearing his message of peace. Then, at the point where his foot touched the ground, the stones turned to opals, sparkling with all the colours of the rainbow.

Key dates

1705–2013

1700

1705 The astronomer Edmond Halley identifies the comet that now bears his name

1900

Early 1900s Australian prospectors begin to mine the site at Lunatic Hill

English astronomer Edmond Halley

1980

1986 The opal is unearthed on 3 November at Lightning Ridge, in New South Wales

1990

1991 The nodule enters *Guinness World Records* as the largest uncut black opal

1992–95 The Halley's Comet opal is displayed at the Australian Mineral Museum in Sydney

2000

2010

2013 The opal is auctioned at Bonhams in Los Angeles

Opal mine in rural Australia, showing the typical open-cut technique used to mine opals, whereby material is extracted from the surface rather than from deeper ground using tunnels

> **... opal resembles a fraction of the rainbow softened by a milky cloud**
>
> Charles **Blanc**
> Author

Moonstone

△ **Cameo-carved** portrait with distinct blue sheen

Moonstone, an opalescent variety of anorthoclase and other feldspars, has been used in jewellery for centuries. Ancient Romans believed it came from solidified rays of the moon, and linked it to their lunar deities. Typically made up of layers of sodium- and potassium-rich feldspars, moonstone has a blue or white sheen – the result of the scattering or reflection of light by tiny intergrowths of minerals. The gem marketed as "rainbow moonstone" is more properly classified as a colourless labradorite (see p.169).

Specification

Chemical name Sodium potassium silicate (Anorthoclase)
Formula $(Na,K)AlSi_3O_8$ | **Colour** Colourless, white
Structure Triclinic | **Hardness** 6–6.5 | **SG** 2.6
RI 1.50 | **Lustre** Vitreous | **Streak** White | **Locations** India, Sri Lanka, Tanzania, Kenya, New Zealand, Australia, Norway

Rough

Rounded pebble | The pitted surface of this water-worn moonstone pebble has the appearance of frosted glass. The best gem material is often found in this form.

Shimmering stone | In this specimen, each layer of feldspar reflects light, which causes a soft sheen or bright iridescence to shimmer with an ethereal glow.

Moonstone rough | This large piece of uncut moonstone shows typical iridescence caused by minute interlayerings of rock affecting the path of light.

Cut

Oval cabochon | With a high dome and subtle iridescence, this moonstone is excellent quality. Moonstone is mainly cut *en cabochon* to bring out the sheen.

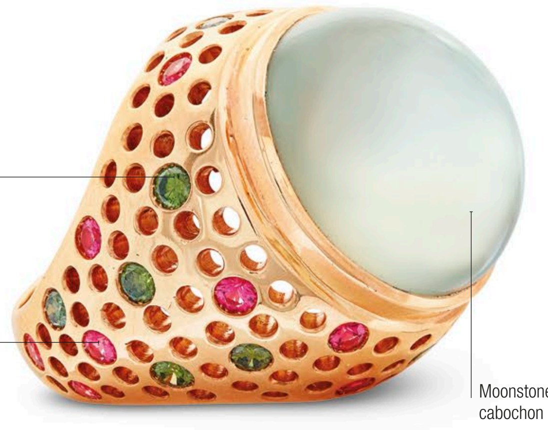
Cameo carving | The iridescence of moonstone adds shadows and highlight to carvings, giving an impression of depth, as in this example.

Colour

Unusual hue | This cabochon has a dark honey tint to the base material combined with typical light iridescence like the shine of the moon after which moonstone is named.

Blue transparency | This unusually fine moonstone cabochon cut from a near-transparent rough has a bluish iridescence that makes the stone glow.

Settings



Innovative ring | This high-set ring features a number of round gemstones set within the sides, topped with a high-domed cabochon of moonstone.

Cartier Paris Nouvelle Vague ring | This gold ring is set with a large moonstone, as well as sapphires, diamonds, chalcedony, turquoise, lapis lazuli, and aquamarine.

Gold cross | This cross is set with six moonstone cabochons selected for their uniform whiteness, which stands out against the rich gold setting.

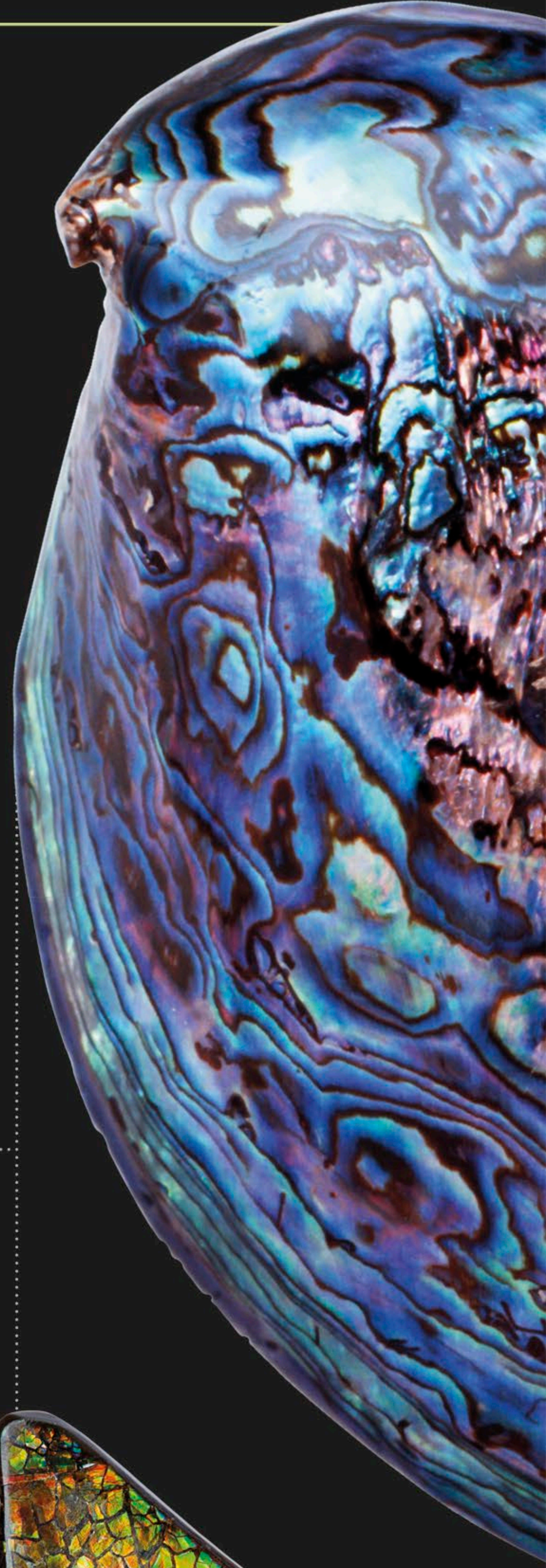
Cartier watch and brooch | This detachable brooch is clipped over a hanging garden of lotus flowers and fish enamelled over a moonstone studded with gems.

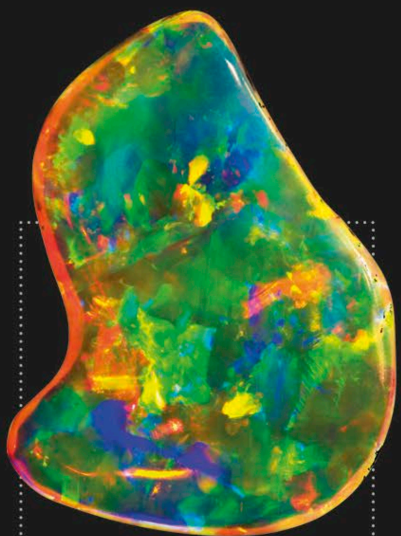
Moonstone is the US state gem for Florida, from where the Moon landings took off – but it does not naturally occur there

Hair combs | Made by Ella Naper around 1906 in the British Arts and Crafts style, these lily-pad hair combs are made of tinted horn applied with moonstones.

Shimmering **colour**

Play of colour is caused by the interference of light interacting with a gemstone. Depending on the internal structure of the gem, light waves bounce off different layers, creating interference. The result is a shimmer of surface or internal colour.

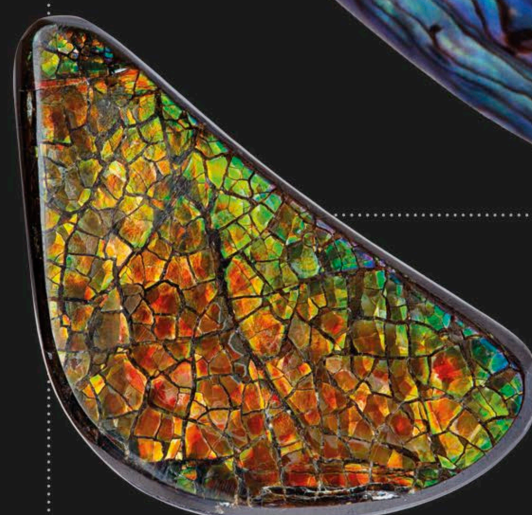




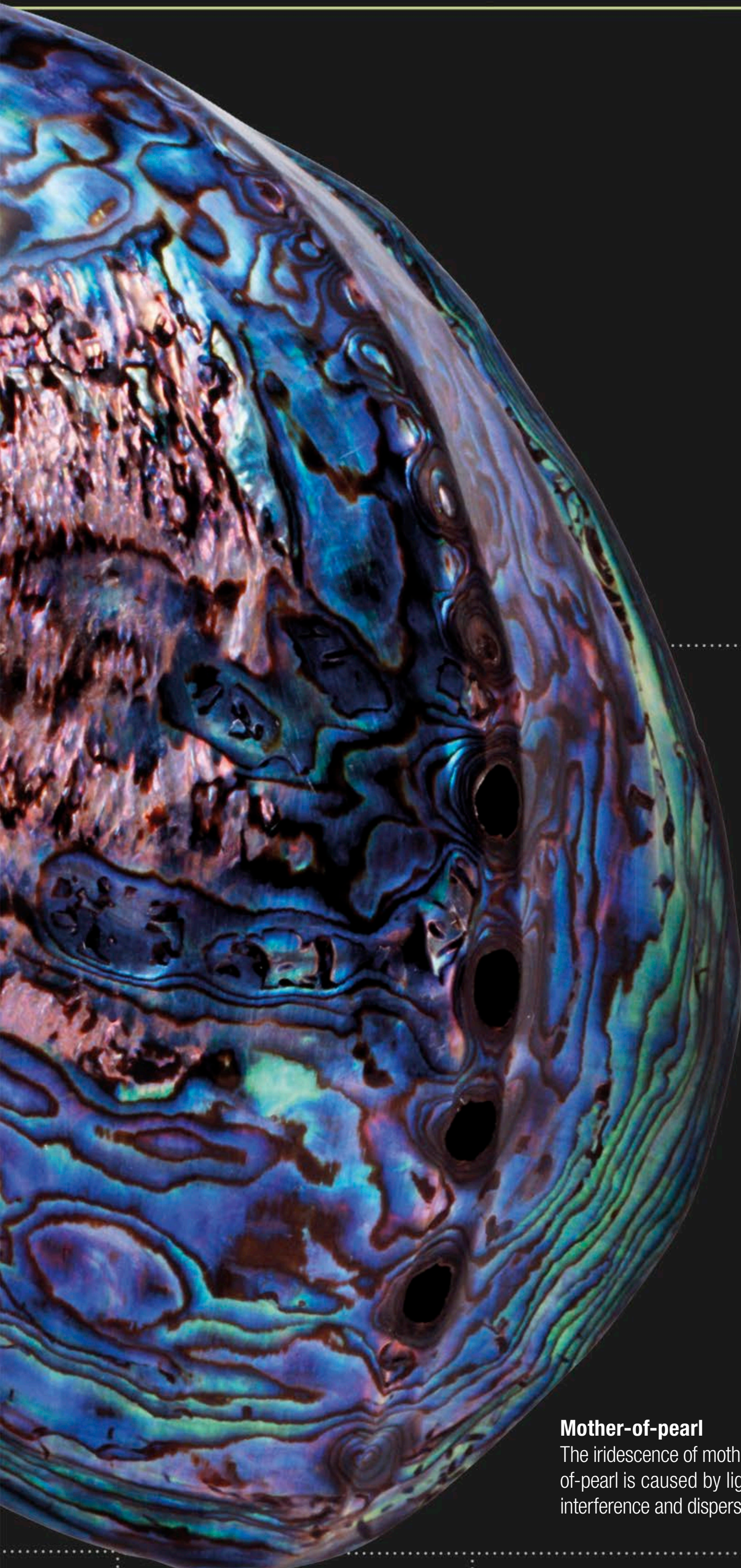
Precious opal
An opal's amazing play of colour is produced by tiny spheres of silica gel, which reflect and diffract light.

Aquamarine
This light blue aquamarine has been faceted to maximize the interplay of light in its transparent interior.

Mystic topaz
This type of gem is a recent innovation, dating back to the late 1990s. The colour effects are artificial, produced by adding a thin, chemical coating to a white topaz; the colours change when the gem is tilted.



Ammolite
A unique combination of high temperature and pressure produces iridescent colouring in these rare organic gemstone fossils.

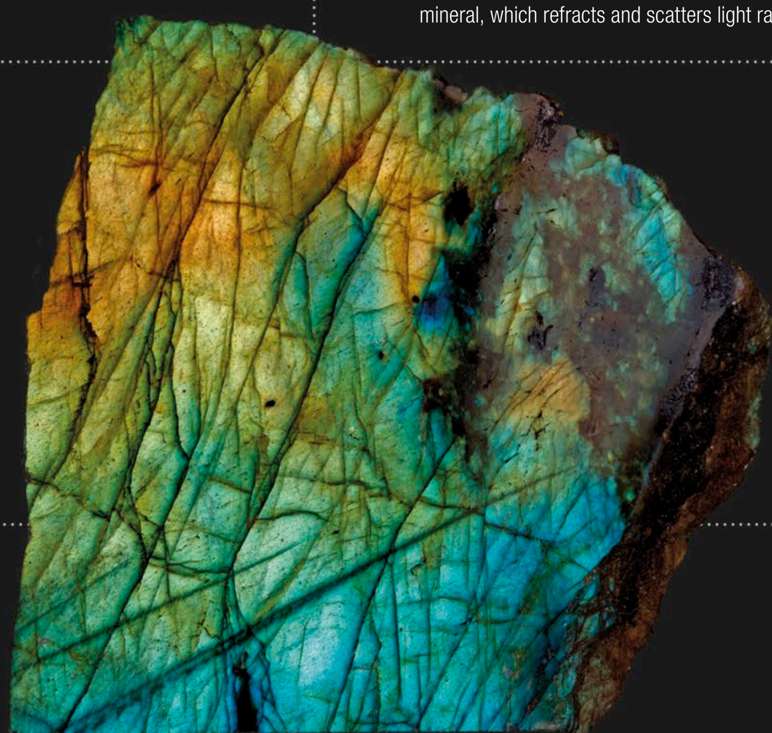


Mother-of-pearl
The iridescence of mother-of-pearl is caused by light interference and dispersion.

Sunstone
This stone's glittering finish, called aventurescence, is caused by tiny inclusions of red copper or hematite.

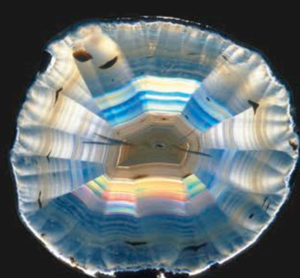
Common opal
Common opal is less sought-after than precious opal (far left), but can still be beautifully coloured, as here.

Moonstone
Moonstone displays an effect called adularescence, caused by the unusual, layered structure of the mineral, which refracts and scatters light rays.



Labradorite
When viewed from certain angles, this feldspar mineral displays an iridescent lustre known generally as the schiller effect (from the German word for "twinkle").

Fire agate
The layering of limonite or iron oxide and silica within this mineral produces its vibrant colouring.



Iris agate
The "iris" or rainbow effect can be achieved with backlighting on agate with fine colour banding.

Sunstone

△ **Marquise-cut sunstone** sparkling with hematite inclusions

Sunstone is a gem that takes its name from its appearance, rather than as a result of the specific mineral it is made from. All types are characterized by minute, plate-like inclusions of iron oxide or copper, oriented parallel to one another, which give the stones a spangled appearance and often a reddish glow. The mineral classification of sunstones can be either oligoclase (a plagioclase feldspar) or orthoclase (an alkali feldspar). Other feldspars also produce sunstone in small quantities. Oligoclase sunstone is the most common type.

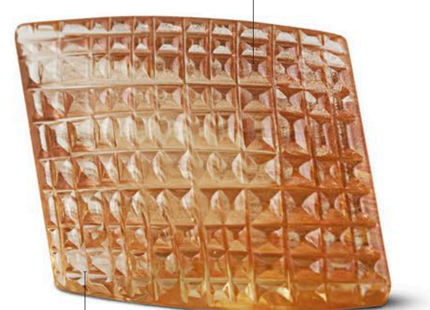
Specification

Chemical name Sodium, calcium aluminosilicate (oligoclase)
Formula $(Na,Ca)Al_2Si_2O_8$ | **Colours** Grey, white, orange-brown, yellow | **Structure** Triclinic | **Hardness** 6.0–6.5
SG 2.62–2.65 | **RI** 1.53–1.55 | **Lustre** Vitreous | **Streak** White | **Locations** USA, Norway, India, Canada, Russia

Oligoclase | **Rough** | This specimen of uncut oligoclase sunstone shows the platy inclusions of hematite in parallel lines that give the gem its typical warm glow.

Fancy cut | **Cut** | This Oregon sunstone in the US national collection was faceted in a triangle cut by award-winning cutters Darryl Alexander and Aivan Pham.

Virtuoso piece | **Cut** | The versatility of sunstone in the hands of a master cutter is shown by this piece entitled “Snowflake”, cut by jewellery artist Darryl Alexander.



Fancy cut | **Cut** | Oregon, USA, is the source of much gem-quality oligoclase. This Oregon sunstone with copper inclusions was faceted by the renowned cutter Larry Winn.

Sunstone | **Cut** | This faceted oval shows the spangled appearance created by the numerous inclusions that raise the mineral to gem-quality grade.

Heart shape | **Carved** | This piece of sunstone from Oregon was carved into a heart by American Naomi Sarna, who specializes in sculptural gem-cutting.

Labradorite

△ **Labradorite rough** in typical gemstone-grade base colour

A type of feldspar, labradorite is named for the Canadian province of Labrador, where it was first identified in 1770. Gemstone labradorite is commonly characterized by its rich play of iridescent colours, principally blue, on broken surfaces. Crystals that display this effect are cut *en cabochon* or used in carvings. Nearly transparent material with a beautiful iridescence comes from southern India. Fully transparent labradorite is found from time to time, and can be yellow, orange, red, or green.

Specification

Chemical name Sodium, calcium aluminosilicate | **Formula** $NaAlSi_3O_8 – CaAl_2Si_2O_8$ | **Colours** Blue, grey, white **Structure** Triclinic | **Hardness** 6–6.5 | **SG** 2.65–2.75 **RI** 1.56–1.57 | **Lustre** Vitreous | **Streak** White | **Locations** Madagascar, Finland, Russia, Mexico, USA; Labrador, Canada

Labradorite in combination | **Rough** | This piece of labradorite rough shows gem-quality blue material interlayered with another feldspar.

Square cabochon | **Cut** | This labradorite cabochon has fine blue, gold, and green schiller. Material like this is found in Mexico and the USA.

Animal carving | **Carved** | The schiller in labradorite, if properly oriented, adds depth and life to carvings, as here. It combines with the vitreous lustre of the mineral to give a glowing, greenish surface sheen reminiscent of the slimy skin of a frog.

Cameo head | **Carved** | Skilful carving through the layers of labradorite brings out flashes of blue, green, yellow, and red as the stone is turned.

Pair of earrings | **Set** | The irregular rounded shapes of these iridescent earrings are set with rows of tiny diamonds around the borders.

Schiller

Lit from within

The iridescence in labradorite is technically called schiller. It is caused by the scattering of light from thin layers of a second type of feldspar that develops through internal chemical separation during the cooling of what was originally a single feldspar. These layers act as diffraction gratings, separating light into its component colours. The colour that results is determined by the thickness of the layers, although the base colour of labradorite is generally blue, dark grey, colourless, or white. High-quality labradorite from Finland is sometimes called spectrolite.

Dramatic coloration
This labradorite specimen has superb schiller.

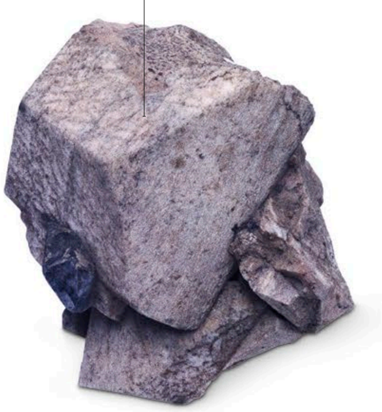
Orthoclase

△ **Rare, 250-carat**, yellow orthoclase gem, unusual for its size and clarity

The pink crystals of orthoclase give common granite its characteristic pink colour. It is also an important rock-forming mineral that yields gemstones. Yellow and colourless orthoclase is faceted for collectors when transparent, and it sometimes produces gems called sunstone (see p.168). A cat's-eye effect results when some yellow and white specimens are cut *en cabochon*. A variety of orthoclase exhibiting adularescence is called moonstone. This adularescence results from the interlayering of orthoclase with albite (see p.172).

Specification

Chemical name Potassium aluminosilicate | **Formula** $KAlSi_3O_8$
Colours Colourless, white, cream, yellow, pink, brown-red
Structure Monoclinic | **Hardness** 6–6.5 | **SG** 2.5–2.6
RI 1.51–1.53 | **Lustre** Vitreous | **Streak** White | **Locations** Myanmar, Sri Lanka, India, Brazil, Tanzania, USA, Mexico



Orthoclase crystal | **Rough** | This orthoclase crystal provides a good illustration of the mineral's classic blocky shape in its natural state.

Gem orthoclase | **Rough** | In this water-worn piece of yellowish orthoclase, a high degree of transparency is readily apparent.

Cabochon | **Colour variety** | Pink orthoclase that is translucent rather than transparent is commonly cut into attractive cabochons, such as this stone.

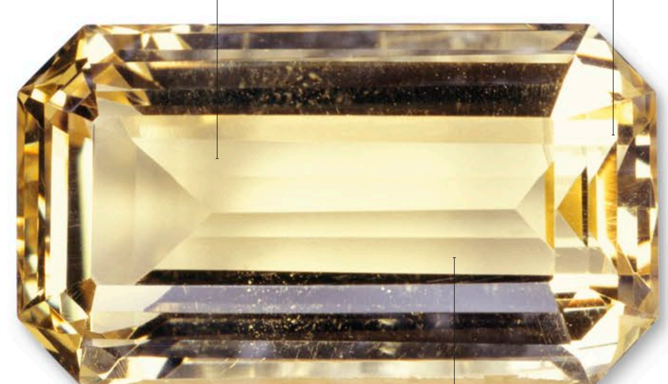
Moonstone | **Cut** | This gem is a cushion, brilliant-cut moonstone (see box, left), exhibiting a characteristic silvery-white texture, emphasized by the cut's many facets.

Sacred moonstone

Legends and beliefs

Orthoclase is one of several feldspars that show a white or silvery adularescence when cut *en cabochon* and are called moonstone. Other moonstones are anorthoclase, sanidine, albite, and oligoclase (see p.164, p.172, p.168). Moonstone was sacred in India, where it was said to inflame passions, and that if lovers placed it in their mouths at full moon, their futures would be revealed. In 11th-century Europe, moonstone was believed to reconcile lovers, and in 16th-century England, a moonstone dedicated to King Edward VI was said to wax and wane with the moon.

Moonstone cabochon This polished cabochon shows characteristic adularescence.



Yellow gem | **Cut** | A lapidary has chosen a rectangular step cut for this yellow orthoclase stone in order to highlight its fine colour and transparency.

Microcline

△ **Rough specimen** of amazonite

Microcline is one of the most common potassium aluminosilicate feldspar minerals; the other is orthoclase. Blue-green to green specimens of microcline are called amazonstone or amazonite. Although deep blue-green is the most sought-after colour, it varies from yellow-green to blue-green and may exhibit white streaks. Gem material is usually opaque and is cut *en cabochon*; it is rarely used for carvings or beads, being relatively brittle. Gem-quality amazonite is found in Minas Gerais in Brazil, Colorado in the US, and the Ural Mountains in Russia.

Specification

Chemical name Potassium aluminosilicate | **Formula** $KAlSi_3O_8$ | **Colours** White, pale yellow, green, blue-green **Structure** Triclinic | **Hardness** 6–6.5 | **SG** 2.6 **RI** 1.52–1.53 | **Lustre** Vitreous | **Streak** White **Locations** Russia, USA, Brazil

Microcline crystals | **Rough** | In this specimen, a cluster of light-coloured, blocky microcline crystals is set in a groundmass of rock.

Amazonite crystal | **Rough** | This superbly formed, blue-green rough amazonite crystal is intergrown with contrasting layers of pink microcline.

Amazonite slice | **Colour variety** | The deep blue-green hue of this rough slice of amazonite is widely considered to be its most desirable colour for use in gemstones.

Cabochon | **Colour variety** | This polished cabochon of amazonite demonstrates the texture and fine turquoise colour of excellent, gem-quality material.

The name "microcline" originates from the Greek for "small slope"

Crystal group | **Rough** | This group of three minerals shows the classic pegmatite assemblage – blue aquamarine and quartz perched on a microcline crystal.

Albite

△ **Nest of gemmy albite crystals** surmounted by brookite

Albite is mainly significant as a rock-forming mineral, but it also has some use as a gemstone. It is found as well-formed, glassy, and brittle crystals, and these are often of transparent, gem quality. However, as it is relatively soft and brittle, albite is faceted exclusively for collectors. Indeed, the variety known as peristerite – a mixture of albite and oligoclase (see p.168) – produces a pleasing bluish, moonstone-like sheen when cut *en cabochon*. The mineral mostly occurs as colourless material, but it can also be yellowish, pink, or green.

Specification

Chemical name Sodium aluminosilicate | **Formula** $NaAlSi_3O_8$ | **Colours** White, colourless, yellow, green
Structure Triclinic | **Hardness** 6–6.5 | **SG** 2.6–2.7
RI 1.53–1.54 | **Lustre** Vitreous to pearly | **Streak** White
Locations Canada, Brazil, Norway

Elbaite tourmaline, quartz, and albite | **Rough** | In this mixed-mineral specimen, albite is host to impressive crystals of pink-purple tourmaline and clear quartz.

Albite and tourmaline | **Rough** | This spectacular specimen features prismatic crystals of elbaite tourmaline resting on albite and quartz.

Albite and topaz | **Rough** | In this striking specimen from Afghanistan, snowy white, gemmy albite is the groundmass for a topaz weighing around 0.5kg (1lb).

Albite group | **Rough** | The white albite crystals in this dramatic group have the characteristic blocky crystal form of albite, and many show twinning.

MIxed-cut albite | **Cut** | This flawless, oval, bluish albite gemstone is faceted in a mixed cut with a brilliant-cut crown and step-cut pavilion.

Bytownite

△ **Marquise-cut** bytownite gemstone

Bytownite is the rarest member of the plagioclase feldspar group; the other members of the group that have gem varieties include labradorite, albite, and oligoclase. Bytownite is seldom found in well-developed crystals, but these can be gemmy when found. Its gemstones are usually faceted, with the transparent gems varying in color from a pale, straw yellow to a light brown. A variety from Mexico is marketed under the name Golden Sunstone, but is different from the various other feldspar sunstones.

Specification

Chemical name Sodium, calcium aluminosilicate | **Formula** $NaAlSi_3O_8 – CaAl_2Si_2O_8$ | **Colours** White, grey, yellow, brown **Structure** Triclinic | **Hardness** 6–6.5 | **SG** 2.7 | **RI** 1.56–1.57 **Lustre** Vitreous to pearly | **Streak** White | **Locations** Mexico, Scotland, Greenland, USA, Canada

Bytownite in rock groundmass | **Rough** | Bytownite seldom forms distinct crystals, but is more often found intergrown with other plagioclases, as here.

Plagioclase | **Rough** | This plagioclase specimen shows surface striations, which are the prime characteristic of all plagioclases, including bytownite.

Polished bytownite | **Cut** | This tumble-polished specimen of bytownite in basalt is one of the more unusual occurrences, with the local name of "Lakelandite".

Fine bytownite | **Cut** | The bytownite material comprising this stone is unusually flawless, and has been faceted in a step-cut cushion.

Bytownite specimen | **Rough** | This rough bytownite crystal originates from Ottawa, Canada, and exhibits a remarkable level of clarity and transparency.

Step-cut stone | **Cut** | The faceter of this emerald-cut bytownite has found an unusually long piece of rough to work from, yielding a striking gem.

Bytownite is one of the minerals known to occur in stony meteorites

David Webb lion bracelet | This crossover bracelet in the form of a lion, made of gold inset with carved lapulis lazuli and diamonds, is a creation of contemporary American designer David Webb.

My heart is mine in the house of hearts, my chest is mine in the house of chests, my heart is mine, and is content with me

From the Egyptian Book of the Dead, Chapter 26, c.1550 BCE, engraved on lapis lazuli

Lapis lazuli

△ **Piece of fine, rich blue** lapis lazuli rough

For over 6,000 years, people have been drawn to the intense blue of lapis lazuli, often flecked with golden glints like stars in the night sky. It is relatively rare, and commonly forms in crystalline limestones as a product of heat and pressure; the strong blue colour is mostly caused by the mineral lazurite, although lapis also contains pyrite and calcite, and usually some sodalite and haüyne. The highest-quality material is a deep, dark blue, with minor patches of white calcite and brassy yellow pyrite. A large quantity of modern lapis material originates from mines in Afghanistan, its original source (see below), while lighter blue material is found in Chile, and lesser amounts in Italy, Argentina, Russia, and the USA.

Specification

Chemical name Sodium, calcium, alumino-silicate (Lazurite)
Formula $Na_3Ca(Al_3Si_3O_{12})S$ | **Colours** Blue | **Structure** Cubic | **Hardness** 5–5.5 | **SG** 2.4 | **RI** 1.5 | **Lustre** Dull to vitreous | **Streak** Blue

Locations
1 USA **2** Chile **3** Argentina **4** Italy **5** Afghanistan **6** Russia

Lapis lazuli in history

For many centuries, the only known deposits of lapis lazuli were those at Sar-e-Sang, in a remote mountain valley in Afghanistan, from where it was widely traded across the ancient world. Objects from ancient Egypt containing lapis lazuli date from at least 3100 BCE and include scarabs, pendants, inlays in gold and silver, and beads. Powdered lapis lazuli was used as a cosmetic – the first eye shadow (along with malachite) – as a blue pigment, and as a medicine. Outside ancient Egypt, the tomb of Sumerian Queen Pu-abi (2500 BCE) contained numerous gold and silver jewellery pieces richly adorned with lapis, and the Chinese and the Greeks were carving lapis lazuli as early as the 4th century BCE.

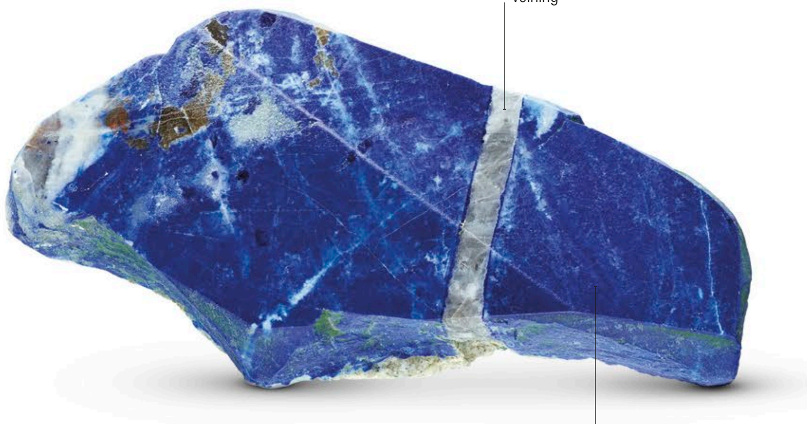
Key pieces

Ancient Egyptian gold pectoral | Featuring a central scarab carved from lapis lazuli supporting a gold disc that represents the sun, this pectoral was created for the pharaoh Amenemopet of the 21st Dynasty, and found in Tanis.

17th-century ewer | Created in the Miseroni workshop in Florence, Italy, around 1608, this ewer was carved from two separate pieces of lapis lazuli. The foot, collar, and handle are made from gold, the handle in the form of a cherub.

Cartier Nouvelle Vague ring | Created by Cartier, Paris, this 18-karat yellow gold ring is set with nine lapis lazuli cabochons and nine chrysoprase cabochons, along with 112 brilliant-cut diamonds.

Rough



Lapis rough | This piece of lapis lazuli rough consists of areas of rich blue colouring, along with large cross-veining of calcite and some substantial inclusions of pyrite. This material could be cut into interesting cabochons.

Streaked rough | The rich blue of this substantial piece of lapis lazuli rough – slightly larger than a fist – is accented by streaks and scatters.of golden pyrite.

Lapis rough | Some lapis rough is almost devoid of pyrite, as in this specimen. It is often preferred for use in inlaid carvings and small cabochons.

The therapeutic stone

Lapis lazuli in ancient treatments

The Greek physician Dioscorides noted in around 55 CE that lapis was an antidote for snake venom; even earlier than this, the Assyrians used it as a cure for melancholy. Another widespread ancient belief was that it protected the wearer from evil because it resembled the night sky, the dwelling place of God. Similarly, a medieval treatise suggests that "meditation upon stone carries the soul to heavenly contemplation", while to the Buddhists of antiquity, lapis lazuli brought peace of mind.

Ancient remedy Ground lapis lazuli, which was sometimes administered as a "medication".

Cut

Polished lapis | Lapis polished in irregular forms, such as this wedge-shaped piece, are desirable decorative objects even without a jewellery setting.

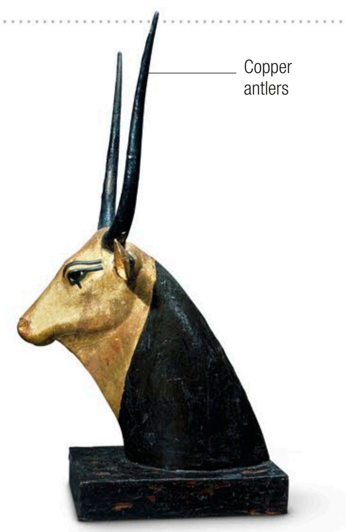
Imitation lapis | Created by Gilson, this cabochon is cut from imitation lapis. It can be identified as synthetic by its uniform colour and unnatural scatter of pyrite.

Chilean cabochon | While ancient lapis came from Afghanistan, the New World source is in Chile. Its material tends to be lighter in colour, such as in this cabochon.

Settings

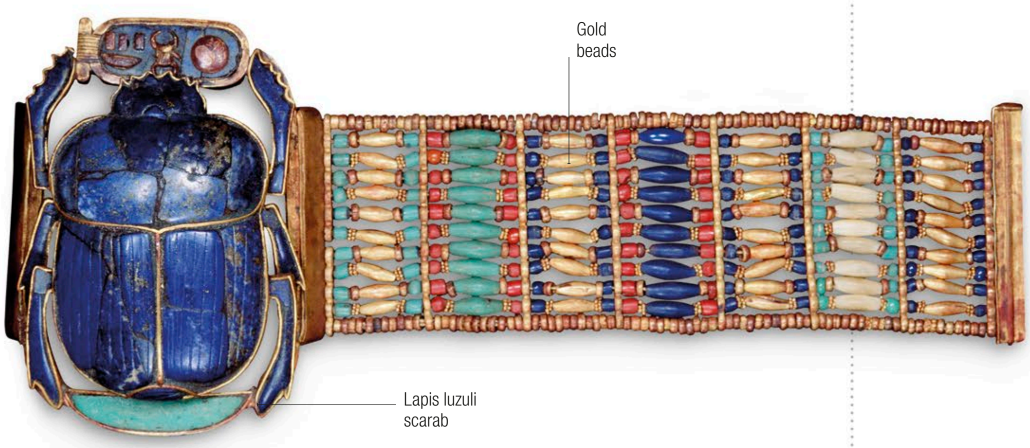
Lapis ring | The square cabochon set in this 18-karat gold ring has fine colour, and includes a beautiful scatter of bright gold pyrite.

Ancient eagle | Originating from the Sumerian civilization around 2650 BCE, this lion-headed eagle is created from lapis lazuli, gold, copper, and bitumen.



Bust of Mehurt | From the Old Kingdom of ancient Egypt (c.1539–1075 BCE) comes this head of Mehurt, the celestial mother, made of lapis, copper, and gold.

The Latin term "sapphirus" probably referred to lapis lazuli, with the modern term derived from the Arabic word "lazaward", meaning "heaven" or "sky"



Ancient Egyptian bracelet | Recovered from the tomb of Tutankhamun, this beaded bracelet features a scarab beetle carved from Afghan lapis lazuli with a turquoise inlay.

Vase | This elegant vase of turned lapis is mounted with gold fittings set with garnets in the base and a top knob of garnet.

Cufflinks | This pair of gold and lapis cufflinks was produced by the House of Bulgari. The inset lapis lazuli material is flecked with sparkling pyrite.

Victorian masterwork | Created in the mid-19th century, this gold pendant features a central lapis cluster surrounded by split pearls and lapis beads.

Tiffany bangle | This 18-karat white gold bangle from Tiffany & Co. is set with inlaid lapis lazuli cut in irregular shapes. It originates from the 1980s.

Chequred bangle | Also created for Tiffany & Co. around 1980, this wavy, 18-karat gold bangle is inlaid with mother-of-pearl, black onyx, and lapis lazuli.

Jewels of ancient Egypt

When archaeologist Howard Carter opened the solid gold coffin of Tutankhamun in 1924, he lifted the lid on the culture of the ancient Egyptians, which dates back as far as 5000 BCE. Egyptian royal burial chambers were steeped in gold, in honour of the gods, and jewellery was placed on the bodies of the dead. Jewels often took the form of a Wedjat – a symbolic Eye of the god Horus – and animals that had religious symbolism.

Vulture collar
This gold vulture, c.1550–1298 BCE, is clutching a *shen* (a ring with a short bar), the symbol for eternity.

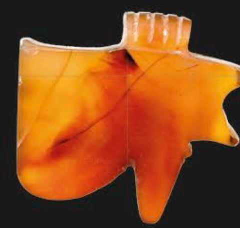
Funerary mask of Tutankhamun
Inlaid with lapis lazuli and obsidian, this gold mask, c.1336–27 BCE, was said to protect the pharaoh so that his soul could be reborn.

Gold swivel ring
This ring features a hinged carving of a sphinx and symbols intended to protect the wearer.

Scarab pectoral
This gold, lapis lazuli, carnelian, and turquoise pectoral from c.1361–1352 BCE takes the form of a scarab beetle.

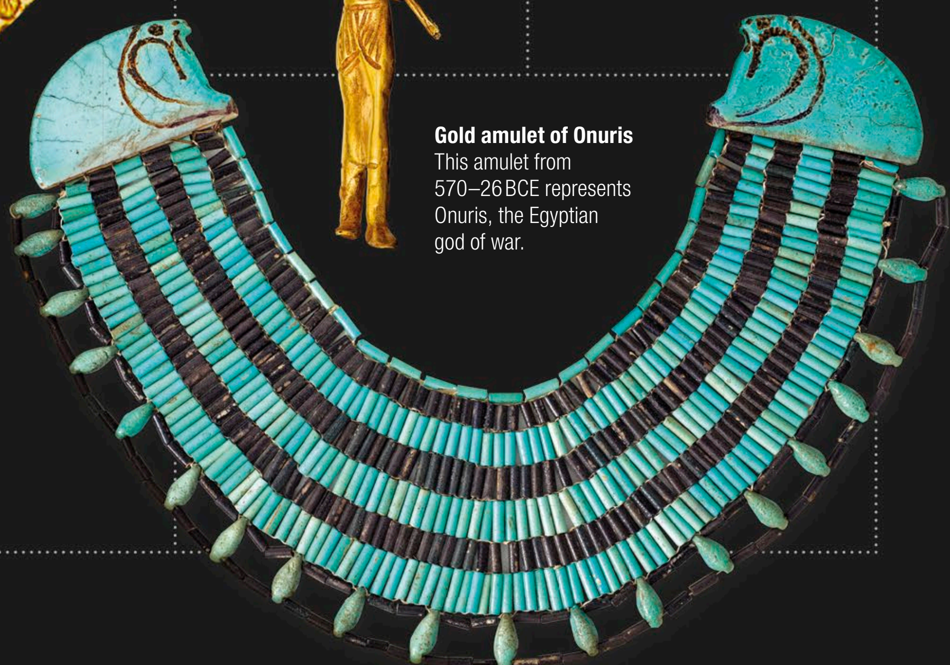
Scarab beetle
Carved from faience (quartz ceramic) c.644–322 BCE, this amulet would have been placed on the heart of a dead loved one.

Wedjat pectoral
This protective talisman was found on Tutankhamun's mummy. It was made from gold with glass paste c.1370–1352 BCE.



Wedjat amulet
This protective amulet, carved in jasper, is a crude, stylized form of the Wedjat Eye.

Gold amulet of Onuris
This amulet from 570–26 BCE represents Onuris, the Egyptian god of war.



Falcon collar,
In Egypt, the falcon was symbol of the god Horus. This necklace of faience beads originates from 1980–1630 BCE.

Shabti servant figurines
Faience figurines such as these, c.1292–1190 BCE, were placed in the tombs of the wealthy.

Bull's head
This lapis lazuli carving in gold mount, c.1070–656 BCE, represents the bull god, Apis.

Sodalite

△ **Faceted oval cabochon** of semi-translucent sodalite

Sodalite is the mineral sometimes mistaken for lapis lazuli (see pp.174–77). It can also be one of the constituents of lapis lazuli, but is visually different, as the latter contains small crystals of pyrite. It is one of only a handful of minerals whose only use is as a gemstone – often veined with calcite, it is favoured by carvers for its interesting patterns. It is usually cut *en cabochon*, but rare transparent material from Mont-Saint-Hilaire, Canada, is faceted for collectors. Single pieces can weigh many kilograms.

Specification

Chemical name Sodium aluminosilicate chloride | **Formula** $Na_4Al_3Si_3O_{12}Cl$ | **Colours** Grey, white, blue | **Structure** Cubic | **Hardness** 5.5–6 | **SG** 2.1–2.4 | **RI** 1.48 | **Lustre** Vitreous to greasy | **Streak** White to light blue | **Locations** Canada, Russia, Germany, India, Canada, USA

Uncut sodalite | **Rough** | This fine piece of sodalite rough demonstrates a good blue colouring with a minimum of the mineral's characteristic white veining.

Sodalite in rock | **Rough** | This specimen features a vivid blue sodalite scattered within the rock groundmass of another, white, feldspathoid.

Fluorescent sodalite | **Colour variety** | When illuminated under ultraviolet light, many sodalite pieces fluoresce (see pp.186–87), as can be seen in this specimen from India.

Yellow fluorescing sodalite | **Colour variety** | Under ultraviolet light, sodalites from different localities fluoresce in different colours (see pp.186–87). This example is Russian.

Sodalite was named in 1811 for its high sodium content

Cabochon | **Cut** | Sodalite is mostly cut *en cabochon*, with the cutter orienting the stone to get the best colour or pattern, as in this example.

Sodalite ornament | **Carved** | Sodalite is reasonably brittle, but in the hands of a skilled carver it can be shaped into pieces that are both attractive and amusing, such as this pig carved from unusually patterned material.

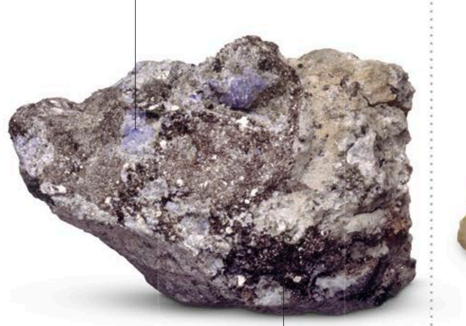
Haüyne

△ **Faceted haüyne** with a modified brilliant cut

Haüyne is one of the components of lapis lazuli, along with pyrite, lazurite, calcite, and sodalite. Blue is the most common colour and occurs in lapis lazuli, but haüyne also comes in white, grey, yellow, green, or pink. Single crystals are sometimes found, and can be faceted only with difficulty – the mineral has perfect cleavage (planes of breakage), which makes it hard to cut without shattering the material. Facet-grade haüyne crystals tend to be small, with faceted stones usually weighing five carats or less.

Specification

Chemical name Sodium, calcium aluminosilicate with sulphate
Formula $Na_3Ca(Al_3Si_3O_{12})(SO_4)$ | **Colours** Blue, white, grey, yellow, green, or pink | **Structure** Cubic | **Hardness** 5.5–6 | **SG** 2.4–2.5
RI 1.49–1.51 | **Lustre** Vitreous to greasy | **Streak** Blue to white
Locations Germany, Italy, USA, Serbia, Russia, Morocco, China



Crystals in matrix | **Rough** | A number of small but good-quality, transparent patches of haüyne crystals are contained within this large rock.

Gemmy crystals | **Rough** | In this specimen a group of small, intensely coloured gemmy crystals of haüyne have developed in a rock groundmass.

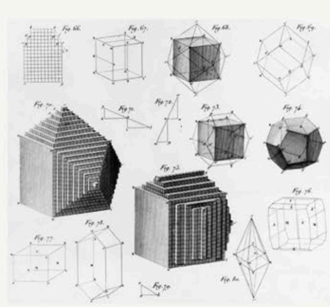
Flawed gem | **Cut** | Gem-quality haüyne is so rare in pieces over one carat that even stones cut from slightly flawed rough are acceptable, as here.

René Haüy's name is one of only 72 that are inscribed on the Eiffel Tower

Napoleon's professor

The father of crystallography

Haüyne is named after René Just Haüy (1743–1822), who grew interested in crystallography when he noticed that fragments of a broken calcite crystal cleaved along straight lines that met at constant angles. He was the first to show that a crystal is built up of tiny, identical units. In 1802 (after imprisonment in the French Revolution), Haüy was appointed Professor of Mineralogy at the Museum of Natural History in Paris. At Napoleon's request, he wrote a book on crystallography.



Illustrated crystals This plate is from *Treatise of Crystallography*, by René Just Haüy, 1822.

Supoerb colour | **Colour variety** | Although far from flawless, the stunning colour of this 0.82-carat, pear-shaped German gem makes it a highly desirable stone.

Kiani Crown | 32.5 x 19.5cm (12½ x 7½in) | Pearls, rubies, emeralds, spinels, diamonds | Shown here in a portrait of Fath-Ali Shah (1762–1834), c.1805

Kiani Crown

△ **Aga Muhammad Khan Qajar**, who created the Kiani Crown in 1796 (shown here around 1820)

A piece of royal regalia like no other, the Kiani crown was the coronation crown in the Persian crown jewels and was used throughout the Qajar dynasty (1796–1925). It was a powerful symbol of royal authority, and is unique in its lavish decoration and for the sheer number of pearls used in its design.

The crown is 32cm (12½in) high without its detachable aigrette (plume), and 19.5cm (7½in) wide. The base of the crown is made from red velvet and is stitched with 1,800 small pearls of 7–9mm (about ¼in) in diameter. Around 300 emeralds decorate the crown, mainly on the aigrette, the largest of which is 80 carats; there are also approximately 1,800 rubies and spinels, the largest weighing 120 carats. Numerous diamonds stud the crown, with a 23-carat diamond as the centrepiece.

Mohammad Ali Shah Qajar (1872–1925) with the crown

The Kiani Crown was created by Agha Mohammad Khan, founder of the Qajar dynasty, in 1796 and modified by Fath-Ali Shah (who reigned from 1797 to 1834), the second of the Qajar kings. Fath-Ali Shah was renowned for his patronage of Persian art, as well as for having 1,000 wives and fathering over 100 children. Five more kings wore the crown at their coronation.

The crown was present, although unworn, at the 1926 coronation of Reza Shah, who seized power in a coup. This brought an end to the Qajar dynasty and the last of the line, Ahmed Shah, fled to Europe. Reza ordered the creation of a new crown, and the Kiani crown became a museum piece.

Key dates

1796–1926

1790 · 1800 · 1850 · 1900 · 1950 · 2000

- **1796** Agha Mohammad Khan Qajar (r.1789–97) commissions the Kiani Crown
- **c1797** The crown is modified by Fath-Ali Shah (r.1772–1834) and possibly worn at his coronation
- **1797** Agha Mohammad Khan Qajar is assassinated
- **1834** The Kiani Crown begins its service as the coronation crown of five subsequent Qajar dynasty kings
- **1926** The Kiani Crown is present, but not worn, at the coronation of Reza Shah, ending the Qajar dynasty. It is subsequently placed in the National Treasury of Iran in Tehran, where it is still on display

Reza Shah with the new crown

The Kiani Crown, Persia's symbol of royal and religious power for around 130 years, displayed at the National Treasury, Tehran

> **It was entirely composed... as to form a mixture of the most beautiful colours**

R Ker **Porter**
Travel writer, on the crown

Scapolite

△ **Fine, oval, brilliant-cut** yellow scapolite gem

Originally believed to be a single mineral, scapolite is the name now given to a group of minerals related by structure, and it is still used in the gemstone trade to refer to any members of the scapolite mineral group cut as gemstones. It is distinctly pleochroic and stones vary in colour when viewed from different angles – violet stones appear dark or light blue, and violet and yellow stones appear pale yellow and colourless. Some scapolites cut *en cabochon* show signs of chatoyancy, a streak of light in the form of a cat's eye.

Specification

Chemical name Sodium, calcium silicate chloride or sulphate
Formula $Na_4(Al_3Si_9O_{24})Cl – Ca_4(Al_6Si_6O_{24})(CO_3SO_4)$ | **Colours** Colourless, white, grey, yellow, orange, pink | **Structure** Tetragonal
Hardness 5–6 | **SG** 2.5–2.7 | **RI** 1.54–1.58 | **Lustre** Vitreous
Streak White | **Locations** Myanmar, Canada, USA, Tanzania

Scapolite crystals | **Rough** | The hollow in this rock groundmass is filled with a cluster of numerous prismatic scapolite crystals, each with four sides of similar length.

Blue crystals | **Rough** | Scapolite comes in a number of colours, but usually forms in metamorphic rocks. These pale, almost translucent, blue crystals are prismatic.

Scapolite cabochon | **Cut** | This highly polished cabochon displays a hazy purple-violet colouring and features visible mineral inclusions.

Cushion-cut gemstone | **Colour variety** | This cushion-cut scapolite stone is notable for its deep brownish-purple colouring. It weighs 2.95 carats.

Mixed-cut scapolite | **Cut** | This beautifully clear example of colourless scapolite is given a striking brilliance by the many facets of its unusual mixed cut.

Museum quality | **Cut** | This 113-carat, yellow, pear-shaped scapolite (shown actual size) is of exceptional clarity and brilliance, and would grace any museum collection.

Scapolite earrings | **Set** | These delicate 18-karat gold earrings are carved from frosted rock crystal, and crowned with pear-shaped, faceted blue scapolites.

Pollucite

△ **Round, mixed-cut** pollucite gem

Discovered in 1846, pollucite is one of two minerals named after Castor and Pollux, the Gemini twins in Greek mythology (see box, below), although the other, castorite, has since been renamed petalite (see p.196). Pollucite is found only in rare element-bearing deposits, where it occurs with other gem minerals such as spodumene, petalite, quartz, and apatite. Facet-grade material tends to be very small, but crystals up to 60cm (24in) across have been found at Kamdeysh in Afghanistan. It also occurs in Italy and the USA.

Specification

Chemical name Cesium sodium aluminosilicate
Formula $(Cs,Na)(AlSi_2)O_6H_2O$ | **Colours** Colourless, white, pink, blue, violet | **Structure** Cubic | **Hardness** 6.5–7
SG 2.85–2.94 | **RI** 1.51–1.525 | **Lustre** Vitreous to greasy
Streak White | **Locations** Afghanistan, Elba, Italy, USA

Pollucite rough | **Rough** | Only an expert cutter will be able to see through the rough, water-worn exterior to glimpse the fine, gem-quality material inside.

Massive pollucite | **Rough** | This piece of massive pollucite was found in Buckfield, Maine, in the USA. This is a broken fragment; well-formed crystals are rare and are especially prized in the jewellery trade.

Mixed cut | **Cut** | This pendeloque pollucite gemstone features triangular facets on the crown and rectangular, step-cut facets on the pavilion.

Octagonal step cut | **Cut** | The rectangular, cushion step cut, faceted to reveal the gem's vitreous lustre, emphasizes the pale blue of this pollucite.

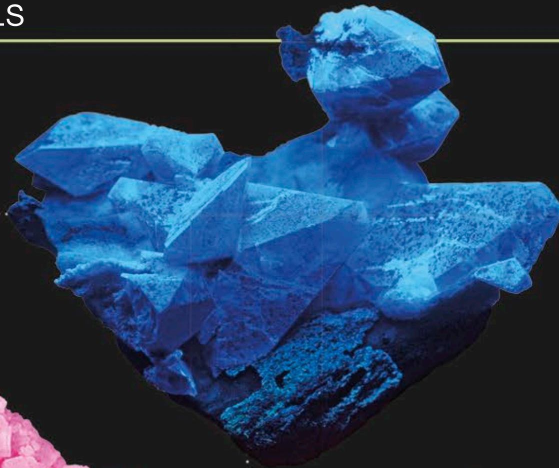
Unusual cut | **Cut** | The cutter of this 2.69-carat, oval pollucite has faceted the gem in an unusual way, accentuating its radiance and exquisite peach hue.

Castor and Pollux

Mythological warriors

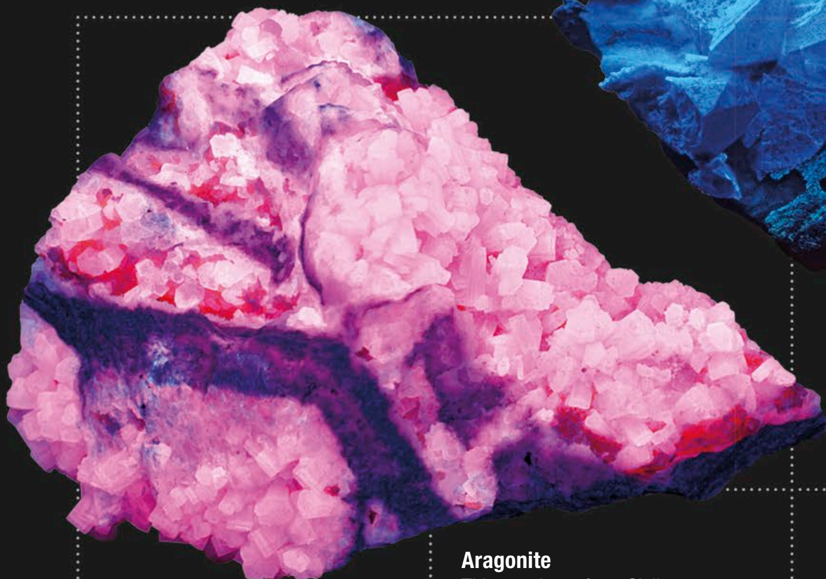
In Greek and Roman mythology, Castor and Pollux were twin brothers renowned for their horsemanship. The Romans believed that their victory at the Battle of Lake Regillus was aided by the mythological twins, and built the Temple of Castor and Pollux in Rome's Forum to honour them. Each year on 15 July, the 1,800 members of Rome's elite cavalry paraded through the city to commemorate the military victory.

Castor and Pollux The brothers are portrayed in these Roman statuettes from the 3rd century CE.

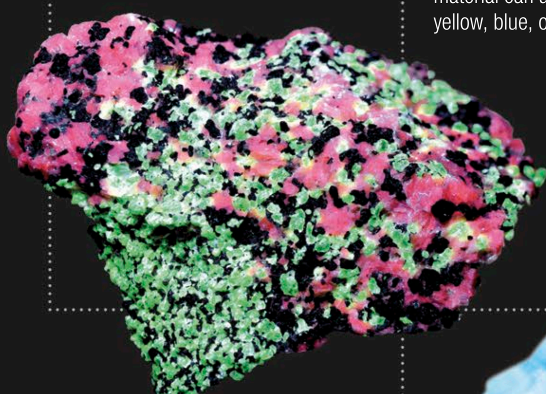


Benitoite
This specimen from California, USA, turns blue under shortwave UV light, as seen here.

Gypsum on rock groundmass
Fluorescence is common in gypsum; this specimen from Paris, France, fluoresces a rich yellow.

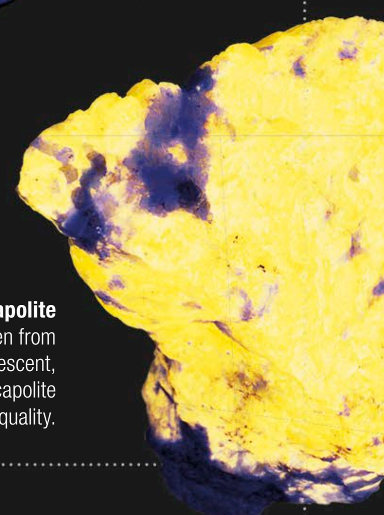


Aragonite
This specimen from Sicily, Italy, fluoresces pink. Aragonite material can also fluoresce yellow, blue, or green.

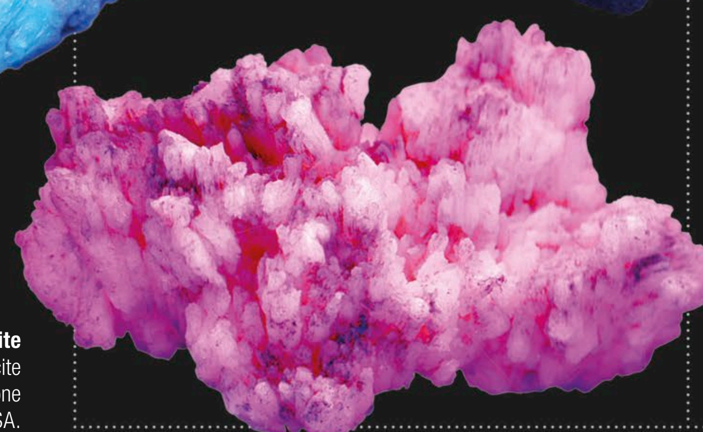


Zinc ore
This specimen contains willemite, franklinite, and calcite, displaying green, black, and pink respectively. It also contains zincite, which does not fluoresce.

Calcite
The columnar crystals of this specimen fluoresce blue-white. Trace elements in calcite can cause other fluorescent colours.



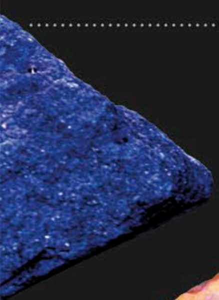
Scapolite
This specimen from Canada is fluorescent, but not all scapolite has this quality.



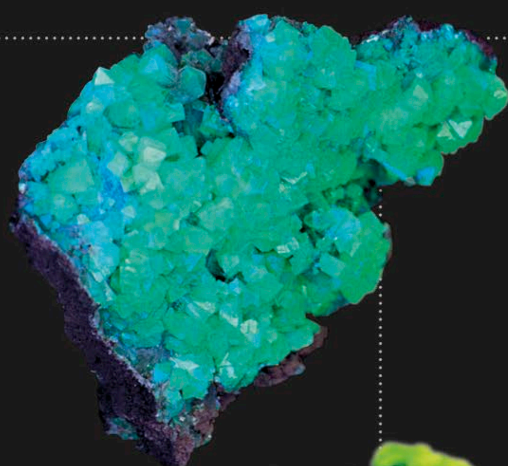
Manganoan calcite
Many types of calcite fluoresce, including this one from Arizona, USA.

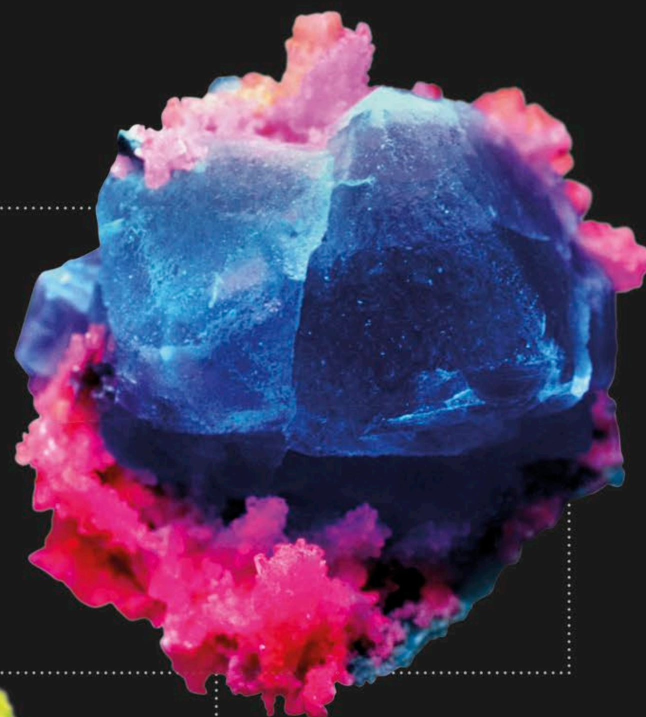
Fluorescent **minerals**

When seen under ultraviolet (UV) light, some crystals glow in eerie, psychedelic colours. First noted in 1824 in fluorite, the phenomenon is called fluorescence. It is unpredictable, as some specimens of a mineral fluoresce, while others, even from the same locality, do not. UV light is produced in long and short waves, and minerals may fluoresce in only one or the other or both.



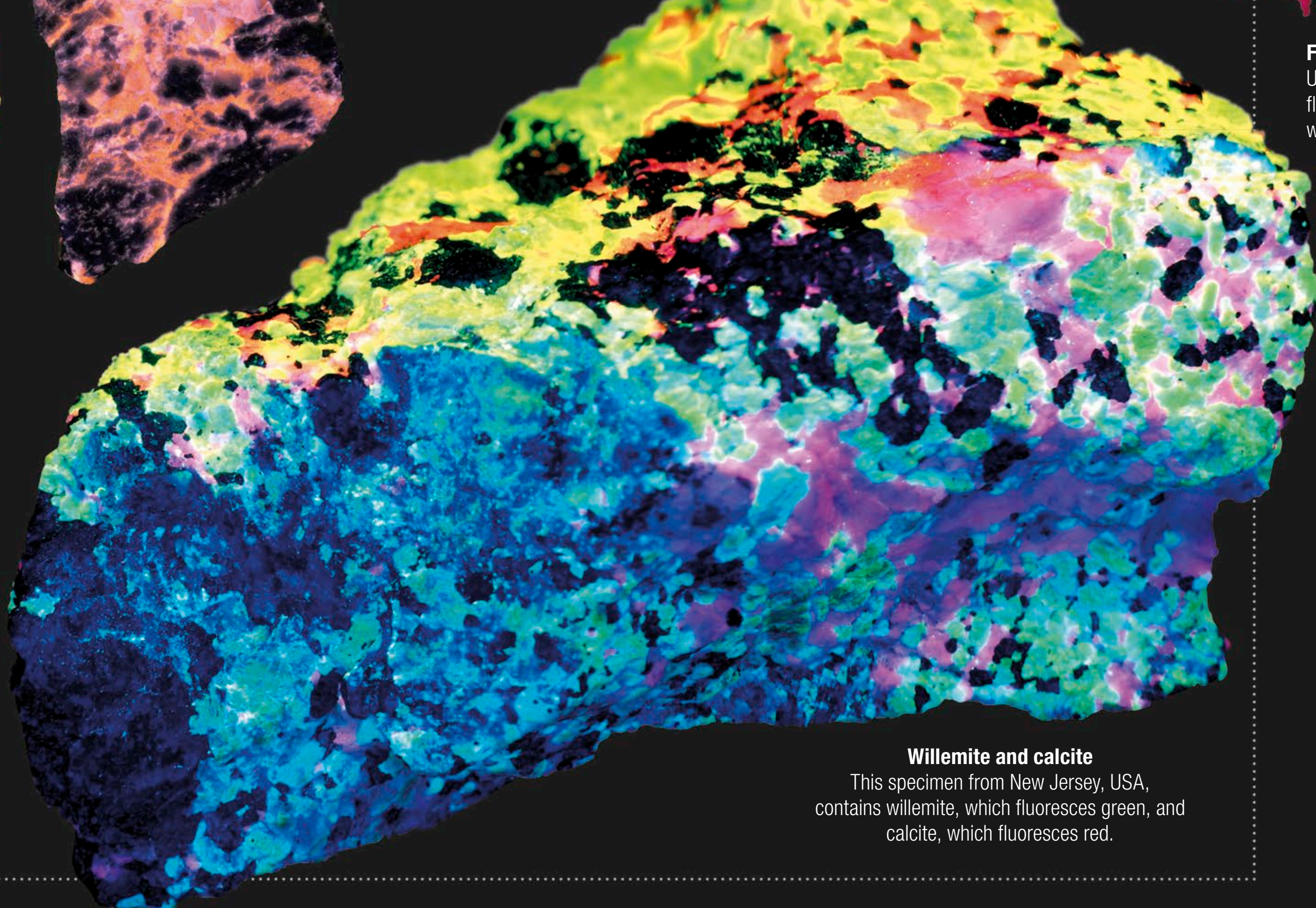
Adamite
The bright green fluorescence of adamite makes it popular with collectors. This specimen is from Mexico.





Sodalite
This sodalite specimen from India fluoresces a vivid orange.

Fluorite and calcite
Under UV light, this specimen's fluorite component turns blue, while its cacite appears red.



Willemite and calcite
This specimen from New Jersey, USA, contains willemite, which fluoresces green, and calcite, which fluoresces red.

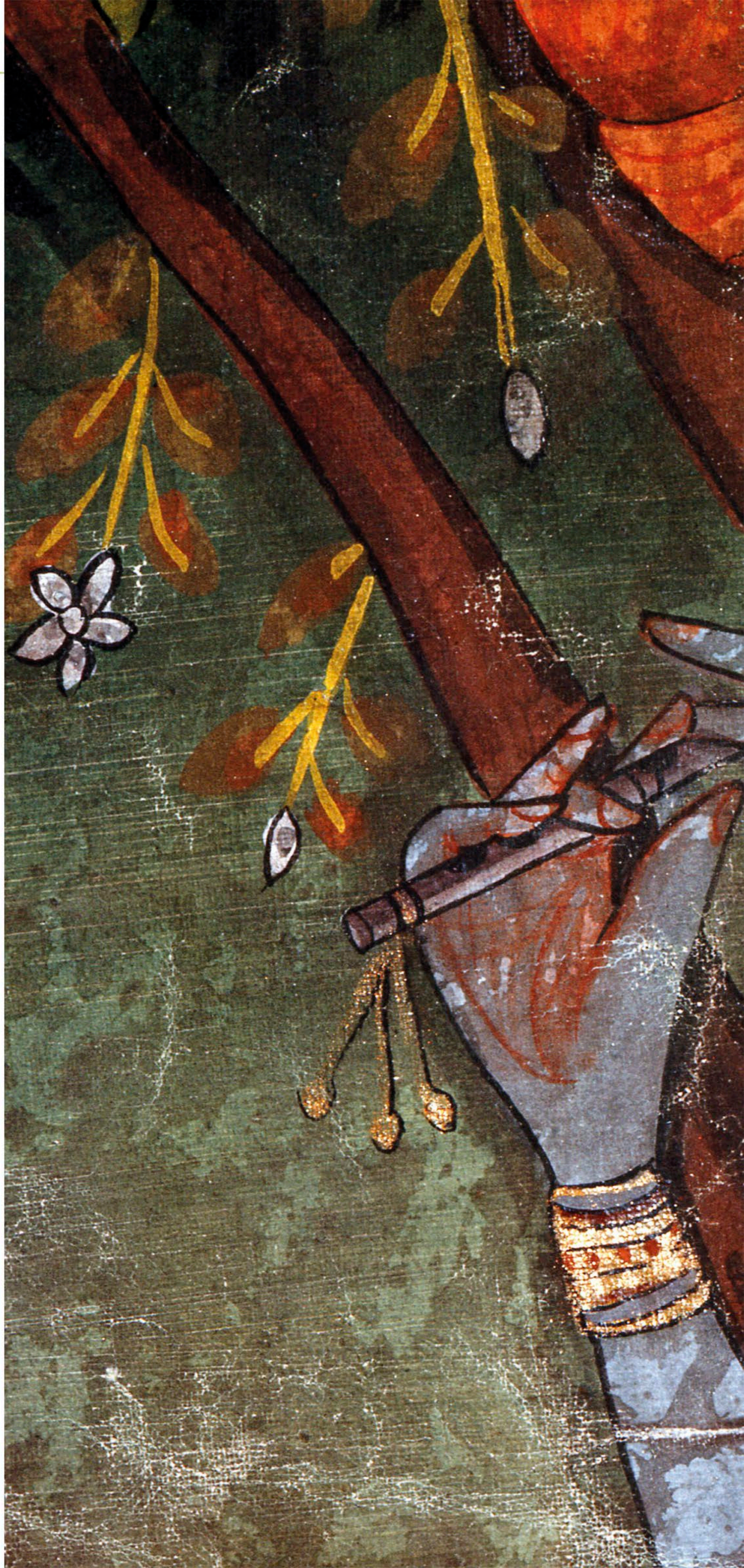
INDIAN JEWELS

For thousands of years, jewellery has played an integral part in the history of India, not only as an art form but also as a spiritual talisman, a signifier of social position, and a means of diplomatic leverage. It was also a motive for political and military conflict, especially during the age of the Mughal emperors (1526–1707). Early jewels were made from stone beads, but Hindu texts from the 1st century BCE refer to a magical jewel called the Syamantaka that originally belonged to Surya the sun god. Able to produce gold and protect whoever possessed it, the jewel sparked clashes among the nobility in their efforts to claim ownership. Historians speculate that the gem was a diamond, possibly the Koh-i-noor, which is now part of the British Crown Jewels (see pp.58–59).

Diamonds have long been the most coveted gems in Indian cultures. Hindu god Krishna is said to have given a diamond to his lover Radha, so that it would reflect her beauty on moonlit nights. Legend says that diamonds were created when lightning struck rock, and they were believed to have healing powers – for example, the wealthy would sprinkle diamond powder on their teeth in the belief it would ward off lightning strikes and prevent tooth decay.

The entire universe is suspended from me as my necklace of jewels

Sri **Krishna**
Bhagavad Gita, 5th–2nd century BCE



Detail of a painting depicting Krishna's youth, 19th century
This painting shows the young Krishna playing the flute and bedecked in jewels, even though he is only a lowly cowherd. The elaborate jewellery elevates him to divine status, the lustre of the jewels outshining the sun.

Serpentine

△ **Serpentine specimen** from Lowell, Vermont, USA

Serpentine is not just one mineral, but a group of at least 16 white, yellowish, green, or grey-green magnesium minerals with a complex chemistry and similar appearance. Serpentine minerals generally occur as masses of tiny, intergrown crystals, and are named in allusion to their mottled appearance, which resembles a snake's skin. Gem-quality serpentine, often with a jade-like appearance, is cut *en cabochon*. Soft enough to be engraved, the mineral is also used in carvings. It is widespread, and there are huge quarrying operations in various parts of the world.

Specification

Chemical name Magnesium, iron, or nickel silicate | **Formula** $(Mg,Fe,Ni)_3Si_2O_5(OH)_4$ | **Colours** White, grey, yellow, green, green-blue | **Structure** Monoclinic | **Hardness** 2.5–5.5 **SG** 2.5–2.6 | **RI** 1.56–1.57 | **Lustre** Subvitreous to greasy, resinous, earthy, dull | **Streak** White | **Locations** Worldwide

High-grade serpentine | **Rough** | The translucency of this example of fine green serpentine shows how it can easily be mistaken for jade.

Serpentine with white chrysotile | **Rough** | Chrysotile is one of the serpentine minerals, and is one of a group of minerals commonly called "asbestos".

Williamsite cabochon | **Cut** | Williamsite is one of the serpentine varieties used as gems, and produces interesting cabochons, as seen in this example.

Neolithic carving | **Carved** | Mysterious serpentine carvings such as this are found in archaeological sites across northern Britain, and date from as long as 4,500 years ago.

Seashell carving | **Colour variety** | Serpentine can come in many colours, such as the light green serpentine of this finely executed carving of a seashell.

Serpentines quarried as ornamental stones are sometimes called serpentine marble

Bowenite pendant | **Carved** | Bowenite is a variety of antigorite, a type of serpentine. Like much serpentine, it can be carved in fine detail, as demonstrated here.

Soapstone

△ **Soapstone** "chop" (seal) from Korea

Far into prehistory, soapstone was used for carvings, ornaments, and utensils. Flint aside, it may be mankind's oldest lapidary material. Today, translucent, light green talc soapstone carvings are widely sold in China, lacquered to improve their hardness and colour, and to make them appear more like jade. The name soapstone is used to describe compact masses of various minerals that have a soapy or greasy feel, the most common of which is talc. A dense, high-purity talc called steatite is sought after for carving.

Specification

Chemical name Magnesium silicate hydrate | **Formula** $Mg_3Si_4O_{10}(OH)_2$ | **Colours** White, colourless, green, yellow to brown | **Structure** Triclinic or monoclinic | **Hardness** 2.2–2.8 | **SG** 2.8 | **RI** 1.54–1.59 | **Lustre** Pearly to greasy | **Streak** White | **Locations** USA, Canada, Germany, China

Uncut steatite | **Rough** | Steatite is a compact form of the mineral talc. The finest examples can be colourful and translucent, as in this piece of rough.

Talc specimen | **Rough** | This uncut soapstone from Roxbury, Connecticut, USA, includes areas of compact mineral suitable for carving.

Steatite cup | **Carved** | This steatite cup from the ancient city of Ur dates back to the 3rd millennium BCE; it is carved in relief with scorpions.

Tumbler | **Carved** | This ancient vessel was carved from one of the many forms of steatite used by the craftsmen in Ur in the 3rd millennium BCE.

Rhinoceros ornament | **Carved** | Soapstone is still a popular material for modern tribal art, such as this polished animal sculpture from Kenya, because it can be carved and incised easily with simple tools.

From ancient to modern

Steatite in history

In the ancient Middle East, steatite was made into bowls, pots, seals, reliquaries, and statues. It absorbs and distributes heat evenly, so it was a good material for cooking utensils and smoking pipes; ancient peoples also carved moulds out of steatite for metal casting. The mineral is still widely carved into bird and animal figures by the Inuit peoples of Canada and Alaska.

Inuit carving This steatite and ivory owl figurine was carved by Inuit craftsmen from Cape Dorset in northern Canada.

Pezzottaite

△ **Unusual crystal** of pezzottaite showing a trapiche structure

Pezzottaite was only formally recognized as a new mineral in 2003, having previously been considered a variety of red beryl (see pp.236–41). Although similar to the crystals found in Utah, USA, its chemical elements differ, and unlike beryl, it crystallizes in the trigonal crystal system. Nonetheless, it has been marketed as raspberyl or raspberry beryl, and it ranges in colour from raspberry red through to orange-red and pink. Most pezzottaite gems are small, between 1 and 2 carats. About 10 per cent will show chatoyancy, or "cat's eye".

Specification

Chemical name Cesium, lithium, beryllium silicate
Formula $Cs(Be_2Li)Al_2Si_6O_{18}$ | **Colours** Raspberry red, orange-red, pink | **Structure** Hexagonal, trigonal
Hardness 8 | **SG** 3.10 | **RI** 1.601–1.620 | **Lustre** Vitreous
Streak White | **Locations** Afghanistan, Madagascar

Pezzottaite rough | **Rough** | This fine, gem-quality, 8.40-carat pezzottaite crystal from a pegmatite found at Ambatovy, Madagascar, shows hexagonal form.

Pezzottaite crystal | **Rough** | Displaying a distinctive form, this pezzottaite crystal is known as an "hourglass" crystal. It features an attractive raspberry tint.

Emerald cut | **Cut** | A fine-quality, pinkish-lavender pezzottaite weighing 0.71 carats, this stone features an emerald cut. Due to pezzottaite's rarity, cut stones are usually small.

New discoveries

One mineral, many names

Pezzottaite is one of many recent gem and mineral discoveries. These are often new types of an already well-known gemstone, such as the transparent blue variety of zoisite (known as tanzanite – see p.253), to the discovery of entirely new minerals such as pezzottaite. Other discoveries have revealed previously unknown variations in existing materials. For example, gem tourmaline is thought to be 11 different minerals, all of which are still referred to as tourmaline in the gem trade.

Rutile needles An inclusion deep within this rose-coloured pezzottaite crystal is a spray of rutile needles.

Cat's eye | **Colour variety** | This richly coloured Madagascan cabochon weighing 3.46 carats displays superb chatoyancy – a cat's eye effect created by internal fibres.

Madagascan pezzottaite | **Cut** | This 4.15-carat oval-cut gem is from Ambatovy in Fianarantosa Province, Madagascar, one of the few locations where pezzottaite is mined.

Sepiolite

△ **Rough specimen** of sepiolite (meerschaum)

Sepiolite is perhaps best known by its popular name – meerschaum, from the German for "sea foam". It is compact, earthy, clay-like, and often porous. Because it is usually found in nodular masses of interlocking fibres, it has a toughness that belies its mineralogical softness. This allows it to be intricately carved, most often in the form of smoking pipes. Meerschaum sepiolite is soft when first extracted and easily carved, but hardens on drying. The most important commercial sepiolite deposit is near Eskişehir, Turkey, where it is found as irregular nodules.

Specification

Chemical name Magnesium silicate hydrate
Formula $Mg_4Si_6O_{15}(OH)_2.6H_2O$ | **Colours** White, grey, pinkish
Structure Orthorhombic | **Hardness** 2–2.5 | **SG** 2.1–2.3
RI Opaque | **Lustre** Dull to earthy | **Streak** White
Locations Turkey, USA, Italy, Czech Republic, Spain

Sepiolite rough | **Rough** | This sepiolite (meerschaum) specimen reveals a compact surface made up of microscopic needles that form a light material able to float on water.

Meerschaum rough | **Rough** | The compact, clay-like nature of light and porous meerschaum (sepiolite) can be seen in this specimen of grey rough.

Meerschaum beads | **Carved** | Although meerschaum is mainly carved into pipes, it can be made into virtually anything, including jewellery, as these fine beads attest.

Meerschaum pipe | **Carved** | Intricately carved with the head of a bearded gentleman wearing a turban, this classic meerschaum pipe has a pipestem made from amber.

Cigar holder | **Carved** | This elaborately crafted cigar holder with claw feet and silver fittings is a fine example of meerschaum carving. A porous mineral, meerschaum develops a delicate brown patina over time.

I want to remain an eternal mystery to myself and others

King **Ludwig II**
of Bavaria

Ludwig II's pocket watch | c.1880 | Gold, diamonds, rubies, turquoise, enamel

Ludwig II's pocket watch

△ **The front of the watch casing**, showing the king's monogram

This 19th-century pocket watch bearing a crown and monogram on the front, and a horse's head on the reverse, was most likely made for King Ludwig II of Bavaria, an eccentric and controversial figure who died in strange circumstances.

The pocket watch was made in around 1880 and consists of gold, enamel, diamond, and ruby, with a matching chain and fob seal. An applied gold-mounted, diamond-set entwined monogram of Ludwig II, surmounted by his crown, adorns the front of the case. On the reverse of the watch, is a silver-mounted, pavé-set diamond horse's head, with ruby-set eye: this elaborate decoration acknowledges Ludwig's passion for horses. The gold-link chain of textured knots and four turquoise- and diamond-set, barrel-shaped links, representing the Bavarian coat-of-arms, terminates in a fob seal of a gold horse leaping from a turquoise cabochon.

Ludwig II of Bavaria, who ruled the country from 1864 until his deposition in 1886

Ludwig II was just 18 years old when he took the throne. Young and good-looking, he was popular in Bavaria, but was little concerned with affairs of state, instead commissioning fanciful constructions such as the fairy-tale Neuschwanstein Castle. His ministers deposed him by having him declared mentally unsound in 1886, and Ludwig was removed to Castle Berg on Lake Starnberg on 12 June. The next day, his body was found in shallow water with that of his minder, Dr von Gudden. His watch had stopped at 6:54pm. Although suicide by drowning was reported as the cause of death, no water was found in his lungs, and his death remains unexplained. This watch – not the one present at his death – was auctioned in 2007.

The music room at Neuschwanstein Castle, the lavish 19th-century castle, still open to visitors today, that was one of Ludwig II's pet projects and where he intended to hide from the public eye

Key dates

1806–2007

1800

1806 Bavaria becomes a kingdom

1825

1835 A new coat of arms is created for Bavaria

1845 Ludwig Otto Friedrich Wilhelm is born on 25 August

1850

1864 Maximilian II dies, and Ludwig II succeeds his father, aged 18

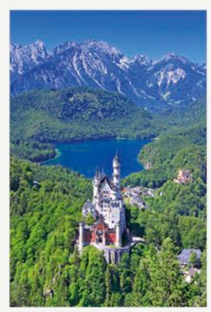
1869 Construction begins on fairy-tale Neuschwanstein Castle, the shy king's prospective retreat

1875

c.1880 Ludwig II's presentation pocket watch is created

1886 On 12 June, Ludwig II's ministers have him declared insane and transport him to Castle Berg on Lake Starnberg. The next day, Ludwig and his doctor, Dr von Gudden, are found dead in the lake's shallow water in suspicious circumstances

1900



Neuschwanstein Castle, in Bavaria

1950

2000

2007 Ludwig's pocket watch is auctioned by Christie's in Switzerland

△ **Opalized** chrysocolla cabochon

Chrysocolla

The term chrysocolla was first applied by the Greek philosopher Theophrastus in 315 BCE (see box, below) to various materials used in soldering gold, derived from the Greek *chrysos*, meaning "gold", and *kolla*, meaning "glue". Chrysocolla forms as a decomposition product of other copper minerals, mainly in arid regions, and is often intergrown with harder minerals such as quartz, chalcedony, or opal, yielding a more resilient gemstone variety. It is usually cut *en cabochon*, and translucent, richly blue-green chrysocolla is particularly prized.

Specification

Chemical name Copper hydrosilicate | **Formula** $Cu_2H_2(Si_2O_5)(OH)_4.nH_2O$ | **Colours** Blue, blue-green | **Structure** Orthorhombic | **Hardness** 2–4 | **SG** 2.0–2.4 | **RI** 1.46–1.57 | **Lustre** Vitreous to earthy | **Streak** Pale blue, tan, grey | **Locations** UK, Israel, Mexico, Czech Republic, Australia, DR Congo, USA

Uncut chrysocolla | **Rough** | This freshly broken chrysocolla rough has a granular outside surface, probably concealing fine gem material within.

Egg form | **Carved** | This ornament cut from chrysocolla stands 44.5cm (17½in) tall, potentially making it the world's largest egg carved from this material.

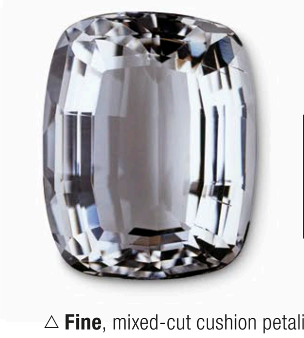
Bird ornament | **Carved** | Weighing 69 carats, this carving by Ronald Stevens of a bird resting on a cluster of berries is one of the all-time finest chrysocolla pieces.

Theophrastus

The man who first described chrysocolla

Theophrastus came to Athens at a young age and studied under Aristotle. He is often said to be the father of botany due to his work on plants, yet he carried out equally important studies of minerals, and his treatise *On Stones* was used by mineralogists until the Renaissance. He was the first scholar to attempt a systematic classification of gems and minerals and, although his work was superseded, he can be considered the forerunner of modern, scientific mineralogy.

Theoprastus A pupil of Aristotle, he was the first person in the ancient western world to write about minerals and rocks.



△ **Fine**, mixed-cut cushion petalite

Petalite

Petalite's name comes from the Greek word for "leaf", a reference to its tendency to break into thin, leaf-like layers. It is usually found as masses of small crystals and, rarely, as individual crystals. In its massive form it is cut *en cabochon*, and its colourless, transparent crystals are faceted for collectors only. Because it is brittle and easily split, it requires extreme care in the faceting process, and it is too fragile to wear. Facet-grade petalite is found principally in Brazil, which produces collectors' gemstones of up to 50 carats in weight.

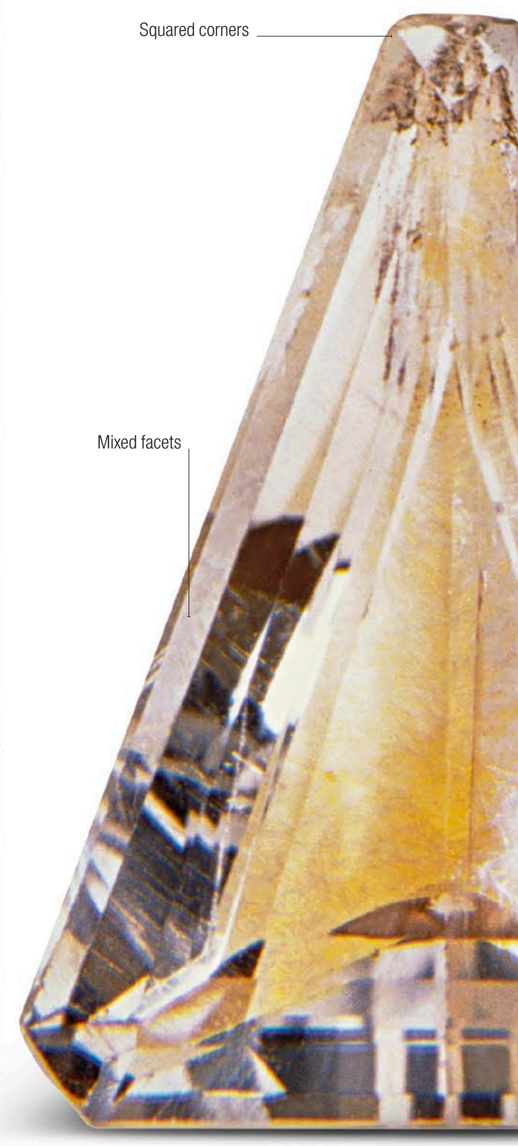
Specification

Chemical name Lithium aluminium silicate | **Formula** $LiAlSi_4O_{10}$ **Colours** Colourless to greyish-white, pink, green | **Structure** Monoclinic | **Hardness** 6–6.5 | **SG** 2.4 | **RI** 1.50–1.52 **Lustre** Vitreous | **Streak** White | **Locations** Brazil, Sweden, Italy, Russia, Australia, Zimbabwe, Canada

Unusual form | **Rough** | This striking grouping consists of several petalite crystals, naturally acid-etched, but retaining some gem material.

Cabochon grade | **Rough** | This rough specimen will be sliced and polished into cabochons, as the raw material needs to be of higher quality for faceting.

Polished petalite | **Carved** | In an unusual decision, a lapidary has shaped this petalite specimen into a baroque form, and then polished it to a smooth finish.



Colour change | **Colour variety** | This rare 6.22-carat stone from Myanmar changes from olive-green in sunlight to fiery red in incandescent light.

The chemical element lithium was first discovered in petalite, which is still an important ore of the element

Burmese petalite | **Cut** | This flawless 25.20-carat smoky-brown, mixed-cut cushion petalite, also from Myanmar, is part of the Smithsonian Institution's gem collection.

Mixed cut | **Cut** | The corners of this yellow, triangular, mixed-cut petalite have been squared off to prevent breakage of the brittle material.

Prehnite

△ **Grape-like prehnite crystal clusters** on a rock groundmass

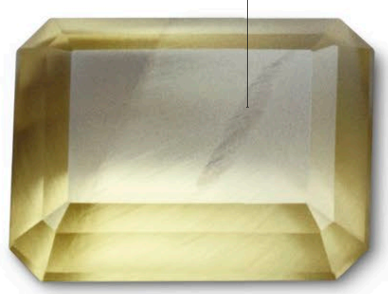
Prehnite is usually found as globular, spherical, or stalactitic aggregates of fine to coarse crystals. Rare individual crystals are often short and stumpy, and have square cross-sections, while some pale yellowish-brown fibrous material shows a cat's-eye effect when cut *en cabochon*. Prehnite is sometimes faceted, but the stones are almost always translucent rather than transparent; faceted stones tend to be small and are cut only for collectors and museums. Semi-transparent prehnite comes from Australia and Scotland, where the occasional near-transparent piece is found.

Specification

Chemical name Calcium aluminium silicate | **Formula** $Ca_2Al_2Si_3O_{10}(OH)_2$ | **Colours** Green, yellow, tan, white **Structure** Orthorhombic | **Hardness** 6–6.5 | **SG** 2.8–2.9 **RI** 1.61–1.67 | **Lustre** Vitreous | **Streak** White | **Locations** Canada, Portugal, Germany, Japan, USA, Australia, Scotland

Prehnite crystals | **Rough** | This specimen consists of a number of single crystals of prehnite of a yellowish colour, resting on a groundmass of rock.

Square cabochon | **Colour variety** | Prehnite is not often found in light blue but, as can be seen in this translucent square cabochon, it can be a subtle pastel colour.



Step-cut stone | **Cut** | Facet-grade prehnite is relatively rare, and is still somewhat cloudy when cut, as can be seen in this step-cut stone.

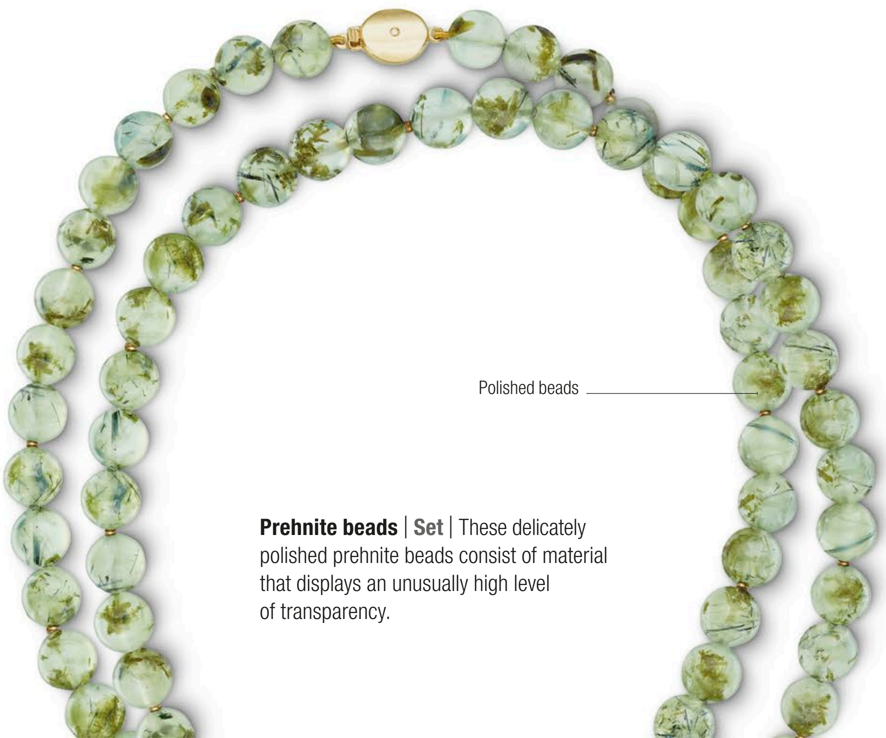
Square cushion | **Cut** | The cloudy quality of this green, square-cut, faceted prehnite gemstone lends the gemstone a somewhat mystical appearance.

Colonel Hendrik von Prehn

The man who discovered prehnite

Prehnite was named after Colonel Hendrik von Prehn (1733–85), and was first described in 1788 at Cradock, Eastern Cape Province, South Africa. Information on Colonel von Prehn is scarce, but he is listed as commander of the military forces of the Dutch colony at the Cape of Good Hope from 1768 to 1780, and as the governor of the Cape Colony. He is also the reputed discoverer of the mineral that bears his name.

Battle off the Cape of Good Hope South Africa was the site of Anglo-Dutch military rivalry in the 17th and 18th centuries.



Prehnite beads | **Set** | These delicately polished prehnite beads consist of material that displays an unusually high level of transparency.

Phosphophyllite

△ **Piece of superb-coloured**, facet-grade phosphophyllite rough

Phosphophyllite is a rare mineral and an even rarer gemstone, highly prized by museums and collectors. Crystals with a delicate bluish-green colour are the most sought after. Phosphophyllite is brittle and fragile, and can be faceted only with the greatest difficulty. It is rare as a gem partly because crystals that are large enough to cut are also too valuable to be broken. The finest crystals, and the ones that provided most of the existing faceted stones, came from the deposit at Potosí, Bolivia, which is now exhausted.

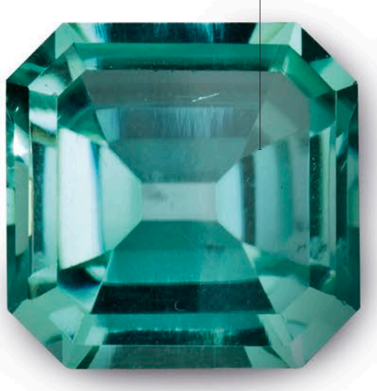
Specification

Chemical name Hydrated zinc phosphate | **Formula** $Zn_2(Fe^{2+}Mn^{3+})(PO_4)_2 \cdot 4H_2O$ | **Colours** Colourless to deep bluish-green | **Structure** Monoclinic | **Hardness** 3–3.5 | **SG** 3.08–3.10 | **RI** 1.59–1.62 | **Lustre** Vitreous | **Streak** White | **Locations** USA, Australia, Germany, Bolivia

Crystals | **Rough** | This specimen features a cluster of light blue phosphophyllite crystals resting on a groundmass of pyrite. The gemmy crystals are of fine quality and would make good faceting material.

High-quality phosphophyllite | **Rough** | Facet-grade phosphophyllite of this transparency and turquoise colour is rare, and will make a first-rate collector's gem.

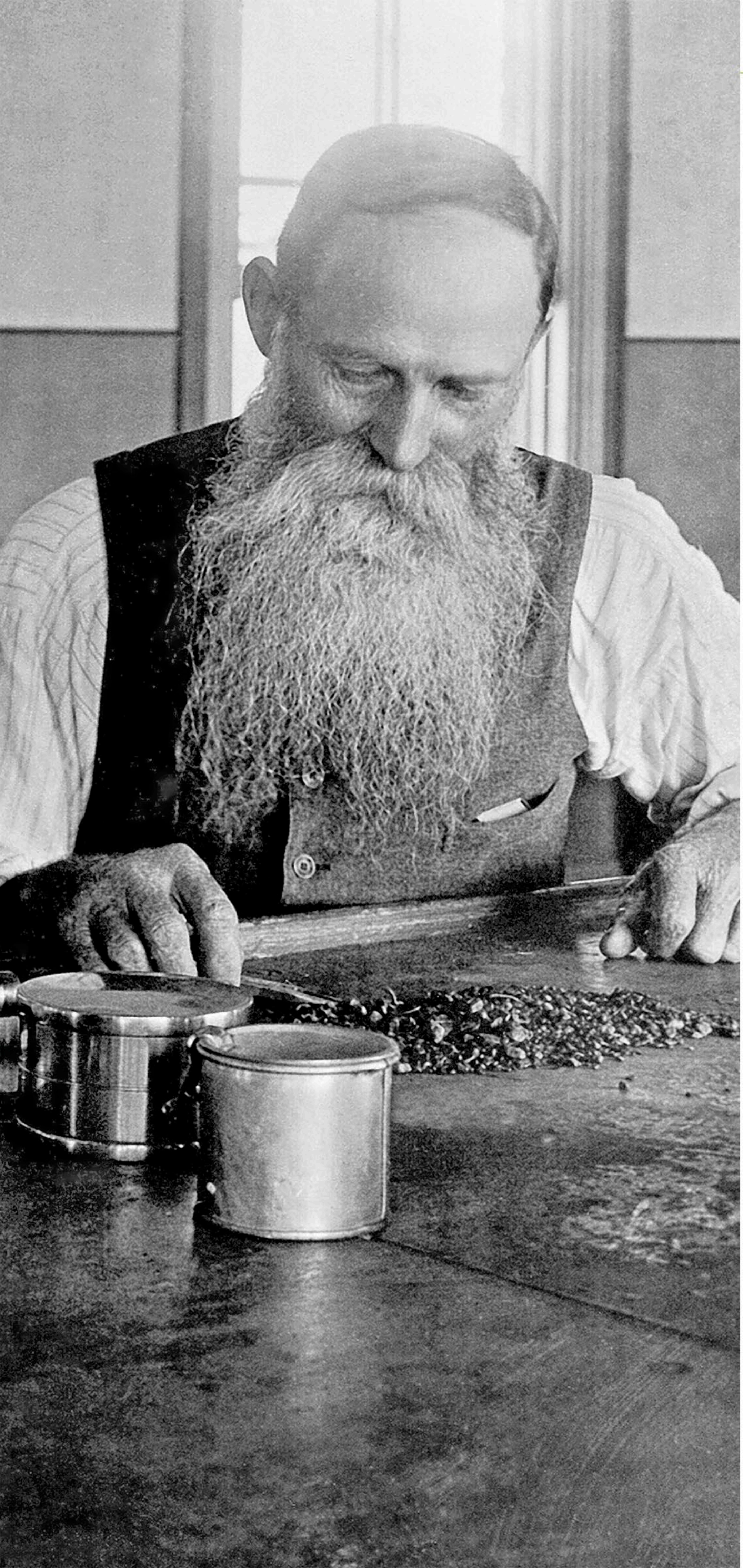
Exceptional colour | **Colour variety** | These phosphophyllite crystals in parallel growth are a stunningly rare colour, and will be sought after by serious gem cutters.



Emerald cut | **Cut** | This light blue-green phosphophyllite gem faceted in an emerald cut has unusual clarity, adding to its value.

Emerald cut | **Cut** | An unusually transparent phosphophyllite is faceted here into an emerald step cut to emphasize its colour and high transparency.

Phosphophyllite is named after the Greek words for "phosphorus-bearing" and "cleavable"



THE GEM INDUSTRY

For thousands of years, diamonds were incredibly rare, but the discovery and mining of huge diamond deposits in South Africa in 1870 not only changed the availability of the coveted rocks, but marked the beginnings of the modern gem industry. Thanks to these mines, world diamond production exceeded 1 million carats per year for the first time in 1871; by 1907 it had reached 5 million carats, and it steadily increased throughout the century, hitting 126 million carats in 2000. Supplies were overflowing as new mines in Angola, DR Congo, West Africa, Botswana, Russia, Australia, and Canada contributed to rising output.

Abundant supply should have driven prices down, but the diamond producers acted quickly to maintain the value of their precious commodity. The British conglomerate behind the South African mines formed the De Beers cartel in 1888 to control every aspect of the new diamond trade, from production to marketing. The gem trade as it now exists was born as a result, with market prices dictated by the diamond cartel's strict control of supply and demand, while De Beers' slogan, "A Diamond is Forever", also helped to make diamonds synonymous with love and marriage.

> There was **no brand name** to be impressed on the **public mind.** There was simply **an idea**
>
> N W **Ayer**
> De Beers Advertising Agency

Workers sort diamonds at the De Beers' mine in South Africa
Before 1870, diamonds came from riverbed deposits, mostly in India, Indonesia, and Brazil, but the De Beers mines were primary deposits, yielding diamonds directly from their source in the Earth.

Enstatite

△ **Piece of massive enstatite** suitable for tumble-polishing

While it is an important rock-forming mineral, enstatite's major commercial use is as a gemstone, in colourless, pale yellow, or pale green hues. The most popular colour is the emerald-green variety, known as chrome-enstatite, and its green colour is caused by traces of chromium – hence the name. All colours are relatively rare, and gemstones are faceted or cut *en cabochon*. Mysore, India, produces star-enstatite; Canada produces iridescent enstatite; and the gem gravels of Myanmar and Sri Lanka yield good-quality facet-grade material.

Specification

Chemical name Magnesium silicate | **Formula** $Mg_2Si_2O_6$ | **Colours** Colourless, yellow, green, brown, black | **Structure** Orthorhombic | **Hardness** 5–6 | **SG** 3.2–3.3 | **RI** 1.66–1.67 | **Lustre** Vitreous | **Streak** Grey to white | **Locations** India, Canada, Myanmar, Sri Lanka

Enstatite crystal | **Rough** | Enstatite is rarely found in well-formed crystals such as this, a large specimen that shows the mineral's prismatic form.

Rough specimen | **Rough** | This piece of enstatite demonstrates its occurrence as a rock-forming mineral. It could be cut and polished, but would not yield a gem.

Polished enstatite pebble | **Cut** | This tumble-polished baroque of enstatite shows the multicoloured patterning – in this case in a patchwork-like formation – that sometimes occurs when enstatite is found in conjunction with other minerals.

Enstatite in space

Minerals of the early solar system

The presence of enstatite in certain meteorites implies that it was one of the first-formed silicate minerals in the solar nebula that created the Earth and solar system. It occurs in about 10 per cent of meteorites known as chondrites. These are agglomerations of mineral grains that never became part of large enough bodies to undergo melting and re-crystallization. It is thought that they were first formed near the centre of the solar system.

Stony iron meteorite Known as chondrites, this variety of iron meteorite sometimes carries quantities of enstatite.

Cat's-eye cabochon | **Cut** | Enstatite is one of the minerals that will sometimes produce a star or "cat's eye" when polished *en cabochon*, as in this example.

Oval brilliant | **Colour variety** | This fine-quality, highly transparent yellow enstatite gemstone has been faceted in a modified brilliant oval cut.

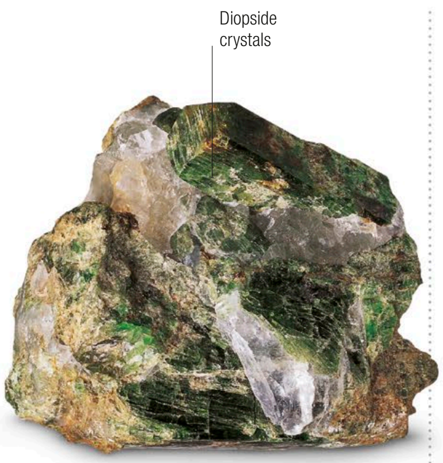
Diopside

△ **Emerald-cut** diopside gem

Diopside is one of the minerals found alongside diamonds in some kimberlite, an igneous rock, generally occurring as dark bottle-green, light green, brown, blue, or colourless stones. Rich green diopside, coloured by chromium and known as chrome diopside, is faceted as a prized collector's gem, and would potentially rival emerald in popularity but for its softness. Stones of another rich hue, a violet-blue coloured by manganese, are found in Italy and the USA – these are sometimes called violane and are highly prized collector's gems.

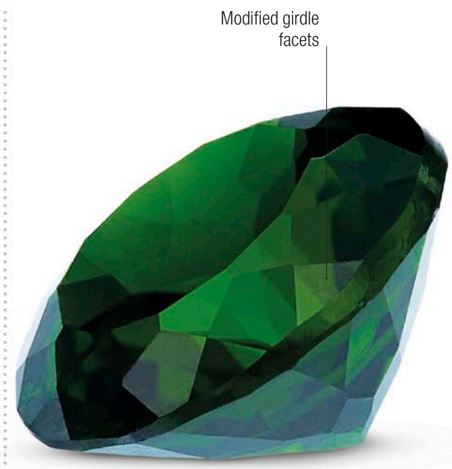
Specification

Chemical name Calcium, magnesium silicate | **Formula** $CaMg(Si_2O_6)$ | **Colours** White, pale to dark green, violet-blue
Structure Monoclinic | **Hardness** 5–6 | **SG** 3.2–3.4
RI 1.66–1.72 | **Lustre** Vitreous | **Streak** White to pale green
Locations Italy, USA, Myanmar, Austria, Canada, Pakistan, Sri Lanka



Diopside crystals | **Rough** | This specimen consists of a number of prismatic, green crystals of diopside embedded in a groundmass of quartz.

Violane | **Rough** | Rich purple diopside is sometimes called violane, and is shown here in massive form suitable for cutting into cabochons.

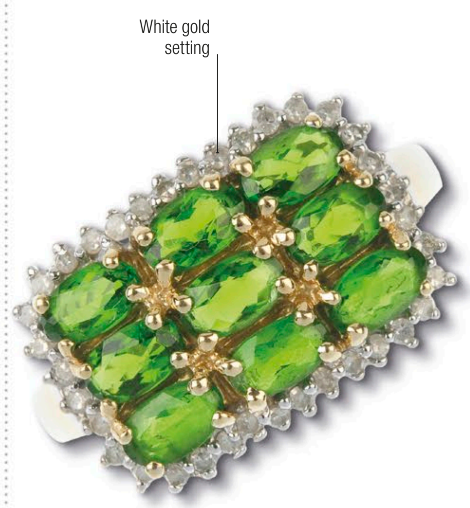


Modified brilliant | **Cut** | Viewed side-on, this richly coloured diopside can be seen to have modified girdle facets on the crown, and main facets on the pavilion.

Chrome diopside | **Colour variety** | This deep green chrome diopside gemstone features a particularly fine colour, emphasized by its clean emerald cut.

Fibrous diopside material can be cut into cabochons to show cat's-eye patterning

Interesting flaws | **Cut** | Although this long, rectangular step-cut diopside features a number of flaws, they add to the character and interest of the gemstone.



Ring | **Set** | Dark green diopside is considered the most desirable colour, but lighter green, as in these matched stones set in a ring, has its own beauty.

Hypersthene

△ **Banded hypersthene rough** with crystal striations

The name hypersthene is still retained as a gemstone variety, even though it has been largely abandoned as a mineral name (the mineral is now considered a middle member of a related series of silicates called pyroxenes). Hypersthene is commonly grey, brown, or green in colour. As a gem, it is noted for its copper-red iridescence, caused in part by inclusions of the minerals hematite and goethite. It is most frequently cut *en cabochon* because it can be too dark to facet. When faceted, stones are often somewhat cloudy, although intense in colour.

Specification

Chemical name Magnesium, iron silicate | **Formula** $(Mg,Fe)(Si_2O_6)$ | **Colours** Grey, brown, green | **Structure** Orthorhombic | **Hardness** 5.5 | **SG** 3.35 | **RI** 1.65–1.67 | **Lustre** Vitreous | **Streak** White | **Locations** India, Germany, Norway, Greenland

Rare, high-quality crystal | **Rough** | Hypersthene occasionally forms well-developed crystals, such as this double-terminated crystal resting on a rock groundmass.

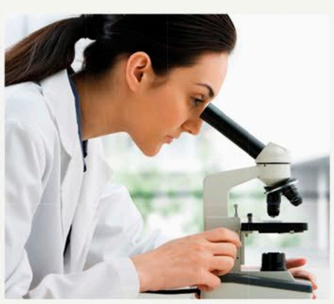
Hypersthene rock | **Rough** | Hypersthene in its rough form, as here, can resemble the mineral hornblende, and so the two are often confused. Hypersthene is the harder mineral.

Tumble polish | **Cut** | Like all gemstones, hypersthene comes in a number of grades. The lowest-grade material is often tumble polished, as in this example.

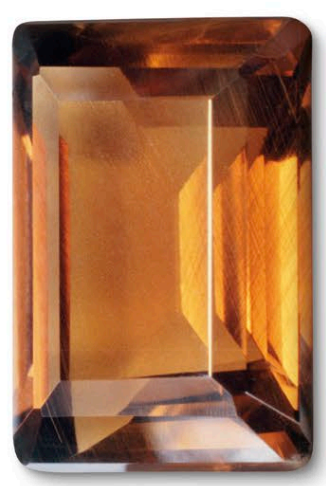
Once a gem, always a gem

Pyroxene or hypersthene?

As scientific instrumentation evolves, previously unknown chemical nuances in minerals are revealed. This can affect the naming conventions that apply to them, particularly in terms of the different requirements of science and commerce. For example, now that hypersthene is known to be a member of the mineral series pyroxene, it no longer technically needs a separate name. To the commercial market, however, "hypersthene" is a well-known gem name, and remains in use.



Scientific analysis Close examination of hypersthene has led to it being mineralogically reclassified.



Faceted hypersthene | **Cut** | This rare, step-cut hypersthene shows good colour and clarity, but characteristically lacks brilliance. The corners are rounded to prevent chipping.

Shaped cabochon | **Carved** | This leaf-like carving of the hypersthene variety bronzite glows from platy inclusions (flat, thin mineral crystals), giving it a subtle metallic sheen.

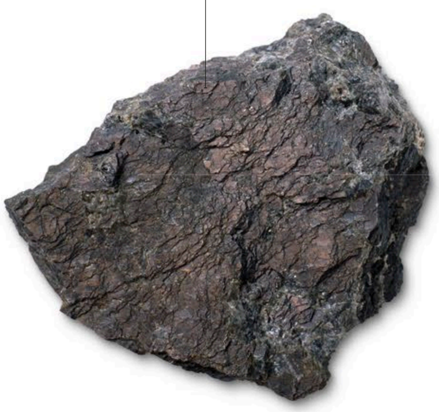
Bronzite

△ **Tumble-polished bronzite** with typical bronze coloration

Bronzite is a member of the mineralogical chemical series that includes hypersthene. The colour of bronzite is green or brown, with schiller (a metallic sheen) that gives it a bronze-like appearance. For gemstone use, it is usually cut *en cabochon*, and it is also carved for small ornamental items. Some bronzite has a fairly distinct fibrous structure, and when this is pronounced, the sheen has a resemblance to cat's eye (see pp.84–85). The general use of bronzite as a gemstone is less extensive than that of its mineralogical cousin, hypersthene.

Specification

Chemical name Iron, magnesium silicate | **Formula** $(Mg,Fe)(Si_2O_6)$ | **Colours** Green, brown, bronze | **Structure** Orthorhombic | **Hardness** 5.5 | **SG** 3.35 | **RI** 1.65–1.67 | **Lustre** Vitreous | **Streak** White to grey | **Locations** India, Germany, Norway, Greenland



Bronzite rock | **Rough** | The characteristic bronze sheen that gives the stone its name can be seen on the surface of this specimen of bronzite rough.

Tumbled bronzite | **Cut** | Tumble polishing is a popular means of revealing the bronze-like appearance of the stone, as seen in this piece.

Smooth pebble | **Cut** | The best coloration in bronzite is not always evident from the rough. This specimen has been polished to a smooth finish, revealing its rich colour.

Bronzite is named for its colour, which resembles polished bronze

Bronzite cabochon | **Cut** | This rectangular bronzite cabochon has been cut with rounded corners to help avoid chipping. The high dome and smooth surface reveal the bronze-like character and translucency of the material.

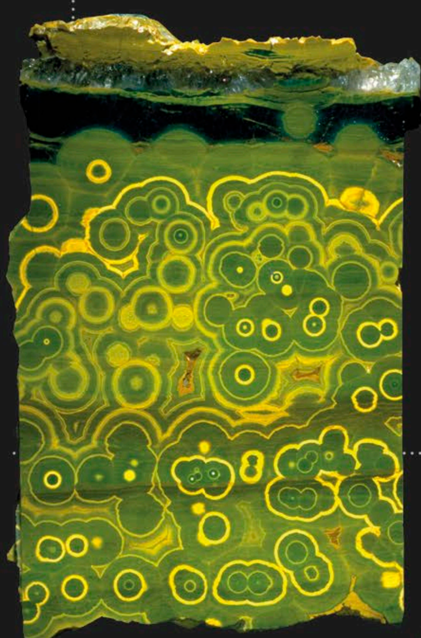
Pattern, texture, and **inclusions**

Some gems grow in patterns that have a natural beauty, enhanced by a skilful cutter. The many varieties of quartz, including agates and chalcedonies such as jasper, are particularly renowned for their intrinsic decorative qualities. Other species of gem have unusual surface texture or inclusions within the stone that add beauty.

Apatite crystal
This large apatite crystal displays a number of small inclusions in its interior, giving it a fractured appearance.

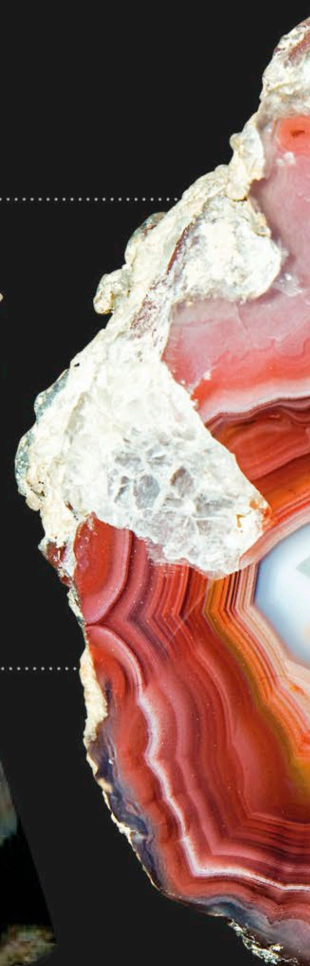
Stained agate
This cabochon of agate has been stained to highlight the patterns created by its mineral inclusions.

Baryte crystals
This cluster of tabular baryte crystals displays a jagged pattern and a waxy texture on its surfaces.



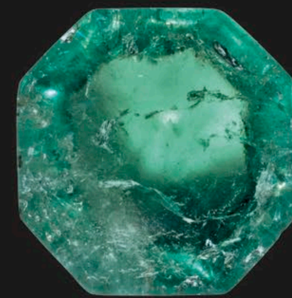
Orbicular agate
This stunning ring-shaped pattern features an "eye" in the centre of each small circle, seen here in a colourful cross-sectional polished slice of agate.

Landscape agate
In this distinctive naturally occurring pattern, images resembling a scene from nature are created by iron oxide dendrites.

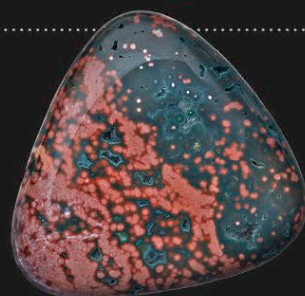


Shell
This striking spiral shell shows perfect geometry in its concentric circles.

Rhodochrosite
This pebble displays natural striations with a banded appearance.



Emerald
This cut stone features the kind of small inclusions and internal cracks often found in emeralds.



Jasper
This specimen's reddish pattern comes from presence of hematite inclusions in varying amounts.

Rutilated quartz
This transparent quartz has cabochon has a number of fine rutile needle inclusions, contrasting with its smooth, polished exterior.

Copal
Copal often carries various small plant or animal inclusions, usually insects or leaves.

Apache agate
Found only on Rancho La Vinata, Mexico, this agate varety displays swirling folds and vivid colour contrast.

Hiddenite

△ **Emerald-cut gem** of the spodumene variety hiddenite

This green variety of the lithium mineral spodumene was discovered by a geologist who had been commissioned by the inventor Thomas Edison to search for any sources of platinum in North Carolina, USA. Mining began in the 1890s at the discovery site, where hiddenite occurred alongside emerald and was, for a time, called "lithia emerald". Hiddenite crystals are small, seldom exceeding 25mm (1in) in length, and are strongly pleochroic, showing green, bluish-green, and yellowish-green when viewed from different directions.

Specification

Chemical name Lithium aluminosilicate | **Formula** $LiAl(Si_2O_6)$ | **Colours** Green, blue-green, yellow-green | **Structure** Monoclinic | **Hardness** 6.5–7 | **SG** 3.0–3.2 | **RI** 1.66–1.68 | **Lustre** Vitreous | **Streak** Colourless | **Locations** USA, Brazil, China, Madagascar

Elongated crystal | **Rough** | While emerald-green is the preferred colour for hiddenite, lighter green crystals, as here, can also be faceted for jewellery.

Hiddenite in gneiss | **Rough** | Crystals have grown here in a gneiss matrix, although hiddenite is usually found in pegmatites (coarse-grained quartz and feldspar mixes).

Gem-quality crystal | **Rough** | This hiddenite rough is transparent and of a fair green colour. It is likely to be cut into an elongated stone (see right).

Navette cut | **Cut** | Hiddenite crystals tend to be elongated, lending themselves to fancy cuts like this 4.96-carat navette cut with a mix of triangular and rectangular faces.

The tiny settlement of White Plains, North Carolina, was renamed Hiddenite after the mineral was discovered there

Elongated gem | **Cut** | The clean lines of the facets emphasize the pale blue-green colouring of this rectangular step-cut hiddenite gem.

Faceted rectangle | **Cut** | This 31.60-carat round-cornered rectangular cut stone from Afghanistan displays excellent lustre and clarity, and is unusual for its large size.

Kunzite

△ **Scissors-cut**, 17-carat gem of the spodumene variety kunzite

Kunzite is the pink variety of the mineral spodumene, and is named after the American gemologist G F Kunz, who first described it in 1902. Faceting-grade kunzite shows strong pleochroism – two different shades of the body colour when viewed from different directions. Gems must be carefully oriented to show the best colour through the top surface; additionally, kunzite tends to be splintery, and slivers are likely to break off during cutting if the stone is not oriented correctly. Kunzite and other spodumene gems are almost always faceted.

Specification

Chemical name Lithium aluminosilicate | **Formula** $LiAl(Si_2O_6)$ | **Colour** Pink | **Structure** Monoclinic | **Hardness** 6.5–7 | **SG** 3.0–3.2 | **RI** 1.66–1.68 | **Lustre** Vitreous | **Streak** White | **Locations** Afghanistan, Brazil, Madagascar, USA

Gem-grade kunzite crystal | **Rough** | This piece of kunzite rough displays excellent colour and transparency, and can be cut into a fine and valuable gem.

Elongated crystal | **Rough** | This crystal is 11cm (4¼in) long, and it can be cut into a desirable stone. The colour is light and delicate rather than intense.

Fancy heart shape | **Cut** | The finest kunzite, when cut by a master cutter, produces some of the finest gems, as this high-quality specimen demonstrates.

Kunzite ring | **Set** | Kunzite gems are often set among colourless diamonds to emphasize their colour – here, the faceted stone is surrounded by white gold and diamonds.

Kunzite earrings | **Set** | Set with diamonds and smaller pink sapphires in 18-karat white gold, these pendant earrings feature two oval-cut kunzites each.

Picasso necklace | **Set** | Designed by Paloma Picasso, this necklace of baroque pearls features a dazzling 396.3-carat kunzite from Afghanistan mounted in gold and accentuated by diamonds.

A style icon who… wore so many jewels they weighed her tiny body down

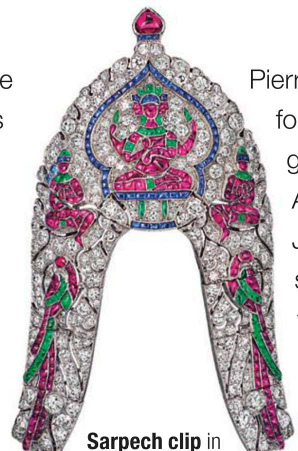
Daily **Mail** on Daisy Fellowes

Tutti Frutti necklace by Cartier | 1936 | Length (open) 43cm (17in) | Briolette-cut sapphires, diamonds, emeralds, rubies, platinum, white gold

Tutti Frutti necklace

△ **Detail** of a briolette-cut sapphire from the necklace

This necklace is one of the most spectacular pieces of Indian-inspired jewellery that Cartier produced. Colourful and exotic, the necklace, which the jewellery house designed for the French-American socialite and heiress Daisy Fellowes in 1936, heralded an exciting new look that came to epitomize the glamour and opulence of the Jazz Age. At the time, this style of necklace was known as a *collier hindou* ("Hindu necklace"), but in the 1970s, Cartier rebranded the range "Tutti Frutti" ("All Fruits"), to highlight the resemblance of the colourful cut gems to berries, leaves, and blossoms.



Sarpech clip in the Indian style by Van Cleef & Arpels

Cartier forged its cultural connection with India in 1901, when Queen Alexandra (wife of King Edward VII) commissioned Pierre Cartier to design a necklace for her to complement three Indian gowns that she had been given. A decade later, Cartier's brother Jacques travelled to the Indian subcontinent, partly to witness the coronation of King George V, but also to make contact with several maharajahs, who wanted their own jewels set with Gallic flair.

These Indian pieces created a sensation in the West, with Cartier's clients queuing up for similar items – Daisy Fellowes's necklace was loosely based on one that Cartier had designed for the Maharajah of Patna. Daisy was famed in society circles at the time, with gossip columnists lingering over details of her scandalous affairs and extravagant lifestyle, but she was also admired as a genuine fashion icon. For her *collier hindou*, Cartier recycled 785 gems from a necklace and two bracelets that she already owned, and added a further 238 diamonds and eight rubies. Completed in 1936, the necklace was a resounding triumph.

Daisy Fellowes wearing the Tutti Frutti necklace at a celebrated costume ball in Venice in 1951, where she masqueraded as the "Queen of Africa"

Key dates

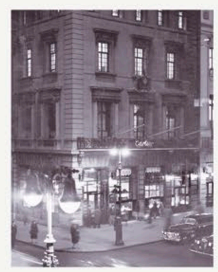
1800s–1990

1900

- **1901** Pierre Cartier produces his first Indian-inspired necklace
- **1911** Jacques Cartier makes his initial trip to India
- **1936** Cartier completes Daisy Fellowes's necklace
- **1937** Photographs of Fellowes wearing the necklace appear in *Vogue*

1950

- **1951** Fellowes wears the necklace at a magnificent costume ball in Venice



Cartier's New York shop, photographed by Alfred Eisenstaedt

1960

- **1962** Fellowes' daughter inherits the necklace and makes alterations to it

1970

- **1970** Cartier coin the term "Tutti Frutti" to describe their Indian-style jewellery
- **1990** The necklace is auctioned in Geneva; Cartier purchases it for a record price of $2,655,172

2000

Jewelry that gleams with wicked memories

New York **Times** on the Tutti Frutti necklace

Jade

△ **Polished jadeite stone** in its most typical colour

There are two distinct minerals both called jade – nephrite and jadeite. They have very different textures: jadeite is made of interlocking, blocky, granular crystals whereas nephrite is fibrous. Nephrite comes only in cream and shades of green, while jadeite comes in many other colours, with white as its pure form. The most valuable is emerald green, which is coloured by chromium and known as Imperial Jade. The name jade comes from the Spanish *piedra de hijada*, “loin stone”, named in the belief that it cured kidney ailments.

Specification (jadeite)

Chemical name Sodium, iron, aluminium silicate
Formula $Na(Al,Fe)Si_2O_6$ | **Colours** White, green, lavender, pink, brown, orange, yellow, red, blue, or black | **Structure** Monoclinic
Hardness 6–7 | **SG** 3.2–3.4 | **RI** 1.66–1.68 | **Lustre** Vitreous to greasy | **Streak** White | **Locations** Myanmar, Japan

Rough

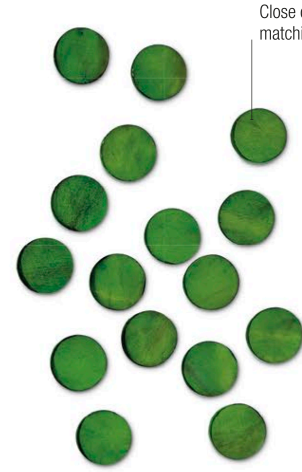
Sawn block | This jadeite block is translucent with good internal colour patterning and a typical sugary, granular texture. Typically, a block in this condition would be in a fit state for a lapidary to carve into decorative shapes or cut up into cabochons.

Slice of veined jadeite | The white streaks in this dark jadeite create an interesting contrast. The green colouring comes from the presence of iron.

Polished jadeite slice | The lavender of this example (caused by manganese) is among the most prized of jadeite colours. The brown skin can be incorporated into carvings.

Cut

Jadeite oval cabochon | The elongated cut and smooth dome of this oval cabochon emphasizes its translucency and blue-green colour cast.



Nephrite cabochons | The round cabochons in this group are well matched for size and colour, so that they can be mounted together in a jewellery setting.

Olmec jade

Jadeite or nephrite

The Olmecs were the first of the Mesoamericans (people of Mexico, and Central and South America) to discover and carve jadeite, but, until the late 16th century, virtually all European jade was nephrite. The Spanish discovered that the Aztecs of Mexico prized a green stone thought to be the same. In 1863, a jade carving was analysed and found to be different. It was named jadeite. For Mesoamericans, jadeite had a similar cultural value to nephrite in China, and was more highly prized than gold.

Votive axehead This Olmec jadeite axehead was carved between 1200 and 400 BCE.

Settings

Gold brooch | This gold swallow in flight carries a nephrite heart. It signifies that, just as swallows always return, so too does the heart of the lover who wears the brooch.

Pi disc | This traditional Chinese pi disc – a thick circle of jadeite with a hole bored into the middle – is said to be a medium of communication with heaven.

Cosmic Clam Ring | Designed by Kent Raible in 2006, this granulated gold clam opens to reveal a gold ring set with jadeite, pearls, and diamonds.

Pendant necklace | Made in about 1925 by Dorrie Nossiter, this pendant incorporates gold, silver, sapphire, tourmaline, and pearls with a central carved jade rose.

Nephrite ring | This white-gold man's ring is mounted with a cabochon of mid-toned nephrite and is framed by diamond-set shoulders.

Nephrite bowl | The carving of this thin-walled bowl shows the colour mottling within the more limited colour range – usually shades of green – typical of nephrite.

Better to be shattered jade than unbroken pottery

Chinese proverb

Portrait of a woman with children, pets, and birdcage | Early 18th century, Qing Dynasty (1644–1912)

Chinese birdcage

△ **Ch'ien Lung**, 18th-century Emperor of China

This ornate antique birdcage from China, festooned with treasures, is more decorative than practical. Featuring finely carved materials and precious stones, it would have introduced an airy aesthetic to a wealthy home.

The cage is 63cm (24¾in) high with a diameter of 33cm (13in), and is constructed from carved wood. The base is lacquered ebony inlaid with bone and ivory, and the cage features carved ivory details, porcelain water and feed bowls, and amber and jade decorations. The cage was primarily produced in the era of Chinese ruler Ch'ien Lung (1735–96), with later additions around 1880–1910.

Around the 17th century, birdkeeping was in vogue, and by the 18th century birdcages were lavish interior design pieces indicating wealth and status. Birdkeeping dates back to 300 BCE in China, and was a popular pastime among Chinese nobility. Songbirds were particularly valued, and some cages were intended to accompany their owner around the house, providing a pleasant soundtrack, much like a modern-day stereo. Some owners took this a step further, and the ornate cage and bird were taken outside for a "walk", a custom that continues today. The cage is swung lightly to encourage the bird to cling to its perch, exercise that helps to maintain its plumage.

Bird owner in Beijing, China, taking his bird out in its cage, c.1930s–40s, photographed by German documentary photographer Hedda Morrison

Qing Dynasty birdcage, thought to have been made around 1735–96, decorated with amber, jade, ivory, bone, and lacquered ebony

> In China, **"birdcage holder"** was a derogatory term for an **idle person**

Key dates

1735–1916

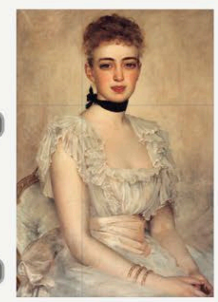
1650

1700

1735–96 The cage is made during the era of Chinese Emperor Ch'ien Lung, known for his interest in the arts

1750

1800



Eleanor Garnier Hewitt, art collector

1850

1880–1910 Additional details are added to the cage

c.1890s The Hewitt sisters, Eleanor and Sarah, travel widely, collecting various artefacts of interest

1897 The Hewitt sisters found the Cooper Hewitt museum in New York City, dedicated to interior design pieces including atypical items, such as birdcages

1900

c.1900s Thomas F Ryan, a US business magnate, acquires a number of artworks and collectors' pieces, including the birdcage

1916 Thomas Ryan donates the birdcage to the Cooper Hewitt, Smithsonian Design Museum

1925

1950

Rhodonite

△ **Tumble-polished** rhodonite gemstone

Rhodonite takes its name from the Greek *rhodon*, meaning "rose". It is a source of manganese and is relatively widespread, but it is usually mined as a semi-precious gem and ornamental stone. It is typically a pink colour; however, material streaked with black veins is also favoured by carvers and cutters. Massive rhodonite is relatively tough, and so is excellent for carving; it is primarily cut *en cabochon* for gems and as beads. Transparent crystals are sometimes found, but they must be faceted with great care, and are strictly for collectors.

Specification

Chemical name Manganese, calcium silicate | **Formula** $(Mn,Fe,Mg,Ca)SiO_3$ | **Colours** Pink to rose-red | **Structure** Triclinic | **Hardness** 5.5–6.5 | **SG** 3.4–3.7 | **RI** 1.72–1.76 | **Lustre** Vitreous | **Streak** White | **Locations** Brazil, Canada, Sweden, Russia, England, USA

Rhodonite crystals | **Rough** | In this specimen, well-developed rhodonite crystals rest on a rock groundmass; crystals such as these are rare.

Rhodonite rough | **Colour variety** | This rough specimen of finest-quality rhodonite displays a typical granular form and a superb colour.

Rhodonite cabochon | **Colour variety** | Material with black veins and streaks, as seen in this cabochon, is favoured by some cutters over the solid rose colour.

Rhodonite box | **Carved** | This spectacular decorative box has been carved from rhodonite that is black-streaked and interlayered with inclusions of quartz.

Rhodonite bear | **Carved** | This black-streaked rhodonite carving of a bear catching a salmon was created in a German gem-cutting centre.

Unusually large crystals of rhodonite have been discovered in Franklin, New Jersey, USA

Walking stick | **Carved** | This head of a walking stick has been carved from fine rhodonite, and is decorated with a platinum royal monogram inset with diamonds.

Pectolite

△ **Tumble-polished** larimar (pectolite) gem

Pectolite is widely found in Canada, England, and the USA, but gem-quality crystals are relatively scarce. Rare faceted stones tend to have internal veils and cloudy areas, and a banded Peruvian variety is sometimes cut *en cabochon*. The type most widely used as a gem is known as larimar, a blue- to blue-green variety found only in the Caribbean. Other forms of pectolite are found in many locations, but none has the unique coloration of larimar (see box, below). Most pectolite jewellery uses silver but, occasionally, high-grade larimar is set in gold.

Specification

Chemical name Sodium calcium silicate | **Formula** $NaCa_2(Si_3O_8)(OH)$ | **Colours** Colourless, white, bluish, greenish | **Structure** Triclinic | **Hardness** 4.5–5 | **SG** 2.8–2.9 | **RI** 1.59–1.64 | **Lustre** Vitreous to silky | **Streak** White | **Locations** Dominican Republic, Canada, England, USA, Greenland, Russia

Larimar specimen | **Rough** | The swirling patterns and intense colour banding typical of larimar rough material can be clearly seen in this piece.

Lotus flower brooch | **Set** | This gold brooch is set with diamonds, sapphires, and two larimar stones – of 51.31 carats and 19.72 carats.

Polished larimar | **Cut** | This tumble-polished nugget of larimar features patches of intense colour and angular patterning.

Larimar statuette | **Carved** | The larimar museum in Santo Domingo, Dominican Republic (see box, below), is home to rough and carved pieces such as this.

Necklace | **Set** | The subtle, pastel blue colouring unique to larimar, seen in this exquisite bead necklace, is one of the reasons for its popularity.

The origins of larimar

Central American sea stone

The inhabitants of the Dominican Republic called the gem "blue stone", believing it came from the sea. It was given its modern name in 1974 by Miguel Méndez, who combined his daughter's name – Larissa – and the Spanish for "sea" (*mar*), into the word "larimar". At first, Méndez and his companion found a few stones on a beach, washed into the sea by the Bahoruco River. They followed the larimar trail upstream, and discovered outcrops of the mineral; these formed the basis of the first mine.

Central America A 17th-century map showing the Dominican Republic, where larimar was first discovered.

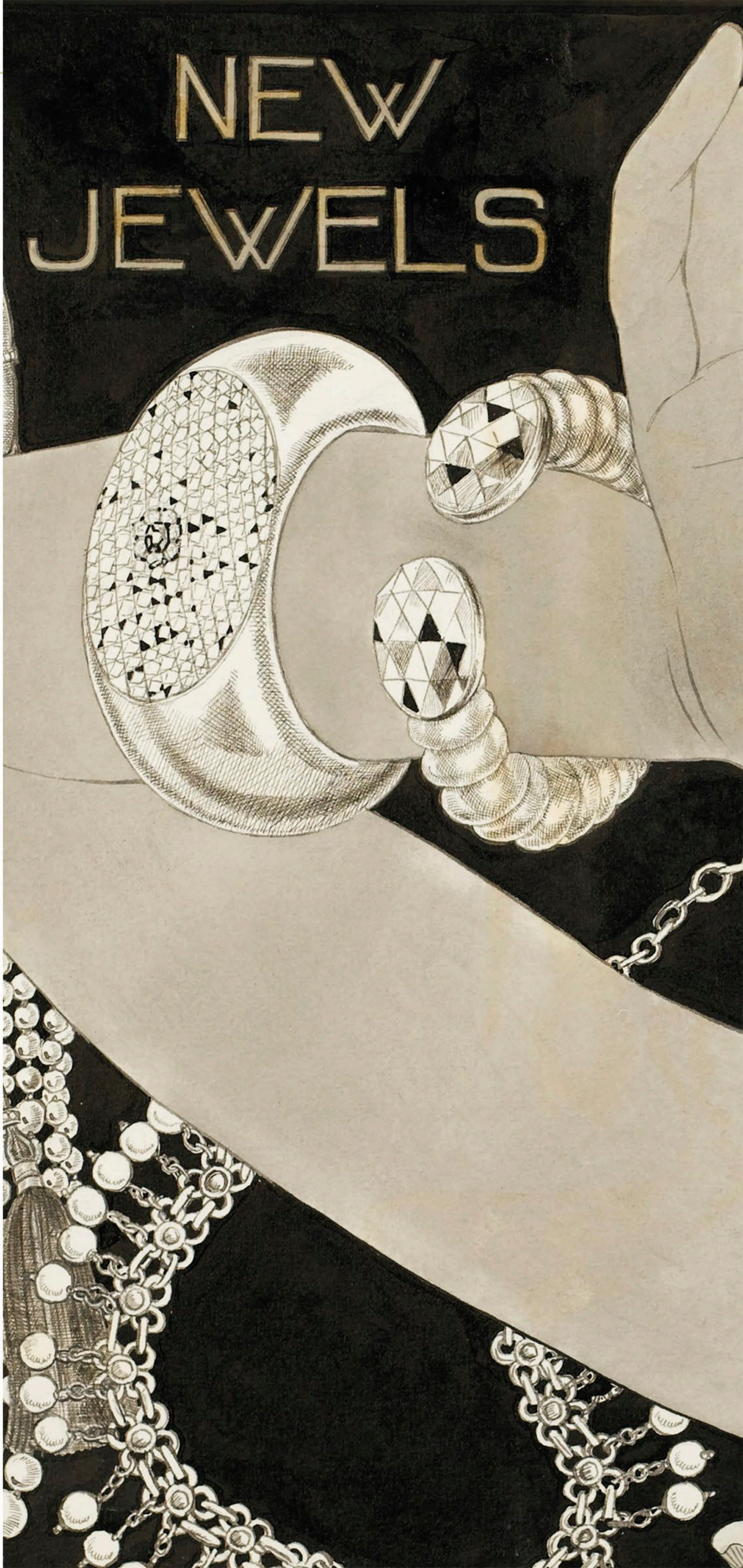
DESIGNERS' HEYDAY

The late 19th century marked the beginning of a creative outpouring in the jewellery world that reached its height in the 1930s. One factor was the abundant supply of large gems on the market from newly opened mines in South Africa. These larger gemstones required lighter settings, challenging jewellers to develop new styles. Britain's Queen Alexandra was another catalyst. Wearing extravagant jewels by day, she personified the *belle époque*, an age of flamboyant, frivolous fashions, and jewels – it was the perfect time to be a jewellery designer.

Among the names to make their mark in the 1930s were the French designers René Lalique, Cartier, Mauboussin, and Boivin, becoming some of the most sought-after design houses in the jewellery world. René Boivin founded his Paris workshop in 1890, but it was not until the 1930s, under the control of Boivin's wife Jeanne, that the house became known for its bold, original pieces. Around this time, Hollywood also bought fine jewellery to the public's attention. Marlene Dietrich commissioned a pair of emerald and diamond bracelets from Mauboussin, one of which she wore in the 1936 film *Desire*; her patronage helped seal the jeweller's fortunes.

It was a toss-up whether I'd go in for diamonds or sing in the choir. The choir lost

Mae **West**
Hollywood actress



An illustration by Georges Lepape for Vogue, 1933 This illustration showcases pieces by some of the leading jewellery houses of the 1930s – Cartier, Mauboussin, and René Boivin. They were all founded in the 19th century, but rose to fame in the 1930s with the help of Hollywood.

Dioptase

△ **Fine dioptase crystals** on a rock groundmass

Bright green dioptase would make a superb gemstone to rival emerald in colour, were it not for its softness and easily set-off cleavage. It is very popular with mineral collectors, but its extreme fragility means that, although it can be cut into a collector's gemstone, these are very susceptible to mechanical shock, and will shatter if exposed to ultrasonic cleaning; even mineral specimens of dioptase must be carefully handled and stored. The name dioptase refers to the gem's highly transparent crystals, from the Greek for "to see through".

Specification

Chemical name Copper silicate | **Formula** $CuSiO_2(OH_2)$ **Colours** Emerald- to blue-green | **Structure** Hexagonal/trigonal **Hardness** 5 | **SG** 3.3 | **RI** 1.67–1.72 | **Lustre** Vitreous to greasy | **Streak** Pale greenish-blue | **Locations** Kazakhstan, Iran, Namibia, Congo, Argentina, Chile, USA

Dioptase on quartz | **Rough** | This spectacular specimen of dioptase crystals on quartz shows why it is a favourite with mineral collectors as well as gemologists.

Large crystals on quartz | **Rough** | In this specimen, dioptase crystals of remarkable form are highlighted by overgrowths of the mineral plancheite.

Brooch/pendant | **Set** | This piece can be worn as a brooch or a pendant. It features 14-karat gold mounting a natural cluster of dioptase highlighted with diamonds.

Superb crystals | **Colour variety** | This striking group of dioptase crystals displays unusually fine crystallization and a deep blue-green colour.

Gemstone with inclusions | **Cut** | Although this dioptase gem has a large number of internal inclusions, its skilled cut and rich colour still make it a fine gem.

Dioptase crystals, mistakenly identified as emeralds, were given to Tsar Paul I in 1797

Bird's nest pendant | **Set** | This intricately textured gold pendant in the shape of a nest has a centrally mounted group of natural dioptase crystals.

Sugilite

△ **Group of top-grade pieces** of sugilite rough

Sugilite was discovered in 1944, but it was only recognized as a mineral in 1976. It is most commonly found in massive or granular form, and rarely found as crystals; when crystals do occur, they are small – less than 2cm (¾in) across. Its colour can be pale to deep pink, brownish-yellow, or purple, with deep hues of the latter commanding the most value. It is always cut *en cabochon* when used as a gemstone, while pebbles are sometimes polished in rock tumblers. Sugilite is named after its co-discoverer, Japanese petrologist Ken-ichi Sugi.

Specification

Chemical name Potassium, sodium lithosilicate | **Formula** $KNa_2(Fe,Mn,Al)_2Li_3Si_{12}O_{30}.H_2O$ | **Colours** Pink, brown-yellow, or purple | **Structure** Hexagonal | **Hardness** 5.5–6.5
SG 2.73–2.79 | **RI** 1.60–1.61 | **Lustre** Vitreous
Streak White | **Locations** Canada, Japan, South Africa, Italy

Sugilite in rock | **Rough** | Within this specimen, a layer of vividly coloured, gem-quality sugilite can be seen sandwiched between two layers of rock.

Sugilite slice | **Rough** | This slice of sugilite rough shows good colour along with black manganese minerals. The cutter will select the best areas for a cabochon.

Polished piece | **Cut** | This polished piece of high-grade sugilite can be used as a cabochon, or simply enjoyed as a fine mineral specimen by a collector.

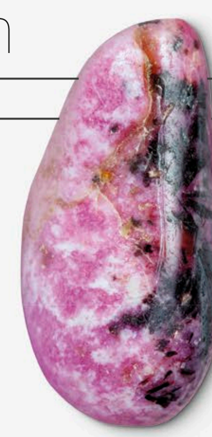
Cabochon | **Cut** | The finest gem-quality sugilite is usually cut into cabochons, such as this elongated oval, high-domed example. It contains a number of small inclusions.

Rare carving | **Carved** | Carved in Idar Oberstein, Germany, from the highest-grade South African sugilite, these herons stand on a base of calcite and have yellow jasper beaks.

The forgotten gem

Sugilite's long road to recognition

Several decades passed between the time when Professor Sugi first discovered sugilite in 1944 and the time by which gem material was found. The original Japanese finds were tiny yellow crystals with no gem value. In 1955, some dark pink crystals were discovered in India, which were also identified as sugilite, but these were not cuttable. Finally, in 1975, a seam of rich purple sugilite was found at a manganese mine in South Africa, the first commercial source.



Tumbled gem The highest-quality sugilite can be fashioned into exquisite cabochons and carvings.

Iolite

△ **Unusual**, round, step-cut iolite gem

Gem-quality blue cordierite is known as iolite, derived from a Greek word meaning “violet”, a reference to its colour. As a gemstone, it is particularly noted for its pleochroism, appearing intense blue in one direction, yellowish-grey or blue in another, and almost colourless as the stone is turned in the third direction. It is almost always faceted, and cutters need to take careful note of the orientation of the stone to obtain the best colour. Another informal name applied to iolite is “water sapphire”, again because of its colour.

Specification

Chemical name Magnesium, iron aluminosilicate | **Formula** $(Mg,Fe)_2Al_4Si_5O_{18}$ | **Colours** Blue | **Structure** Orthorhombic **Hardness** 7–7.5 | **SG** 2.6 | **RI** 1.53–1.55 | **Lustre** Vitreous to greasy | **Streak** Colourless | **Locations** Sri Lanka, India, Canada, Myanmar, Madagascar

Iolite in matrix | **Rough** | This matrix specimen contains numerous gem-quality, dark iolite crystals studded within a quartz groundmass.

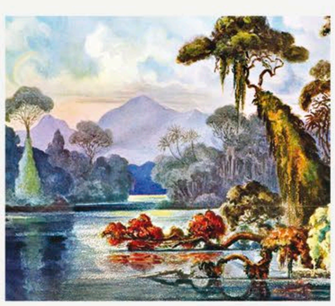
Oval brilliant | **Cut** | The fine, sapphire-blue colour of iolite is beautifully displayed in this oval brilliant, and illustrates its informal name of “water sapphire”.

Iolite cabochon | **Cut** | Although not usually thought of as cabochon material, this rich blue gem shows that iolite can be cut *en cabochon* with dramatic results.

The many names of iolite

Obsolete and current

Iolite is a good example of how gemstone names evolve. “Water sapphire” may have originated because the stone was usually found in water, for example in the gem gravels of Sri Lanka and Myanmar. Another old name is dichroite, a Greek word meaning “two-coloured rock”, a reference to its pleochroism. Yet another obsolete name for iolite is steinheilite, after Fabian Steinheil, the Russian military governor of Finland, who first observed that it was a mineral distinct from quartz.



Sri Lankan scene A print showing Kelani Ganga River in Sri Lanka, a source of iolite gem gravels.

Iolite carving | **Carved** | Iolite is seldom used as a carving material. This charming dog weighs 39.16 carats and is part of a set of various gemstone animal carvings.

Iolite earrings | **Set** | These flower earrings set in 18-karat yellow gold each feature a central, step-cut iolite, with pink tourmalines forming the “petals”.

Benitoite

△ **Deep blue** benitoite gem

Benitoite was discovered in 1906 near the San Benito River in California, from which it takes its name. It is reputed to have been found by a prospector looking for mercury and copper deposits, who came across some brilliant blue crystals he mistook for sapphires. Its best blue colour is seen through the side of its crystals, a fact that imposes a size limitation on cut stones, which seldom exceed three carats. Benitoite has exceptionally strong dispersion: its "fire" is similar to that of diamond, though it is often masked by the intensity of the stone's colour.

Specification

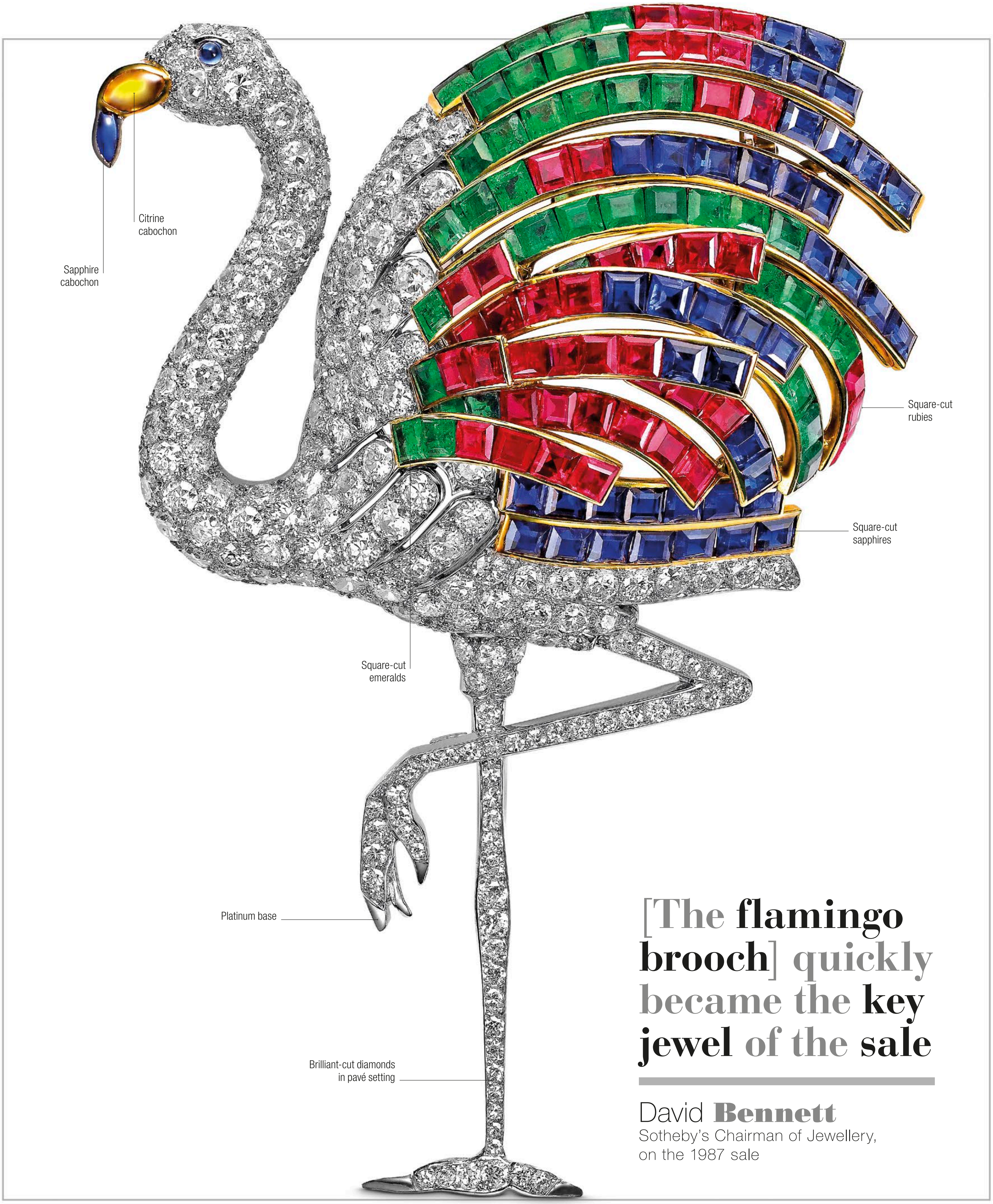
Chemical name Barium titanium silicate | **Formula** $BaTiSi_3O_9$ | **Colours** Blue, colourless, pink | **Structure** Hexagonal | **Hardness** 6.5 | **SG** 3.7 | **RI** 1.76–1.80 **Lustre** Vitreous | **Streak** White | **Locations** USA, Belgium, Japan

Uncut benitoite | **Rough** | Specimens of benitoite are rarely found in rough form weighing over 5 carats – this unusually fine piece weighs nearly 7 carats.

Benitoite crystals | **Rough** | Although the benitoite crystals in this specimen are not gem quality, they are accompanied by calcite, which is typical of the mineral.

Fine gem | **Cut** | The deep colour and natural fire of this benitoite gemstone have been enhanced by the use of a cut that features a large number of facets.

Butterfly brooch | **Set** | Made to celebrate the California state gemstone, this brooch is set with blue and colourless benitoites, with heat-treated orange benitoites for eyes.



[The flamingo brooch] quickly became the key jewel of the sale

David **Bennett**
Sotheby's Chairman of Jewellery, on the 1987 sale

Cartier flamingo brooch | c.1940 | 96.5 x 95.9mm (3¾ x 3¾in) | Diamonds, emeralds, rubies, sapphires, citrine, gold, platinum

Duchess of Windsor's Cartier flamingo brooch

△ **Wallis Simpson**, later the Duchess of Windsor, 1936

This Cartier flamingo was commissioned by the Duke of Windsor for Wallis Simpson, the woman for whom he gave up the British throne. It is one of the most famous of the numerous jewels that he bestowed on her.

The brilliant-cut, calibrated (uniformly sized) diamonds have a pavé setting in the platinum and yellow-gold base to create the glittering body and legs of the flamingo. The plumage of the wings and tail is composed of step-cut emeralds, rubies, and sapphires. The eye is a single sapphire cabochon (a polished rather than faceted stone) while the beak is formed from citrine and sapphire cabochons.

American socialite Wallis Simpson had already been twice divorced when she captured the attention of the heir to the British throne, Edward VIII, in 1934. The prince was determined to marry her at any cost, causing a crisis when the reigning monarch King George V died. Edward was now the head of the Church of England, which did not permit divorcées to remarry. Unable to bring himself to relinquish Simpson, Edward abdicated in 1936, and his younger brother George VI became king, granting Edward the title "Duke of Windsor".

Duchess of Windsor's emerald and ruby 20th-anniversary Cartier brooch

Edward commissioned the flamingo brooch for his wife three years after their wedding. As materials, he supplied one of her necklaces and four of her bracelets to Cartier's director Jeanne Touissant in Paris. Touissant, together with her design partner, Peter Lemarchand, used the reclaimed gems to complete the flamingo jewel in 1940.

The Duke presented the brooch to his wife, now the Duchess of Windsor, for her birthday that year and it became one of her most treasured pieces. After her death it was owned by private collectors, and was exhibited by Cartier in 2013.

Duchess of Windsor's gem and diamond Cartier bracelet

Key dates

1934–2013

1930

1934 Wallis Simpson meets Edward VIII

1935

1936 On 13 December, Edward abdicates in order to marry Simpson

1936 On 22 January, King George V dies and Edward VIII inherits the throne

1937 On 3 June, Edward, now Duke of Windsor, marries Simpson, who becomes Duchess of Windsor

1940

1940 The Duke of Windsor brings a necklace and bracelets to Cartier, Paris to be used in the creation of the flamingo brooch. It is completed and presented to Simpson on her birthday

The Duke and Duchess of Windsor on their wedding day

1960

1972 The Duke of Windsor dies

1980

1986 Wallis Simpson dies

1987 The brooch is put up for auction at Sotheby's

2000

2010 The brooch is auctioned again by Sotheby's

2010

2013 The brooch appears in an exhibition by Cartier. It remains in private hands

2015

Bulgari Gemma watch | Perhaps the ultimate in jewelled watches, this extravagant 18-karat pink gold watch has a face set with tourmalines, diamonds, and amethysts. The band features emerald beads and brilliant-cut diamonds.

Native Americans have used pink and green tourmalines as funeral gifts for centuries

Tourmaline

△ **Faceted 7.79-carat** indicolite tourmaline, side view

Tourmaline refers to a family of borosilicate minerals of variable composition, but all with the same basic crystal structure. There are more than 30 mineral species in the tourmaline group, including elbaite, dravite, and schorl. However, while mineral names are based on chemistry, gemstone names are based on colour and take no notice of tourmaline species. These include indicolite (blue), achroite (colourless), and rubellite (pink or red). The crystals generally form pencil-like prisms, with a rounded-triangular cross-section, and, unlike the rocks in which they often form, tourmaline minerals are resistant to weathering. As a result, they tend to accumulate in gravel deposits; the origin of the name is the Singhalese word *turamali* – “gem pebbles”.

Variety of colours

There is no simple correlation between chemical composition and colour. Most gemstone tourmaline material comes from the species elbaite, which is usually green, although it can occur in many other colours. Emerald green is fairly rare and thus valuable; until the 18th century, it was often confused with emerald. The most dramatic tourmalines are the colour-zoned gems called “watermelon” tourmaline: when sliced across the crystal, this variety shows a red or pink centre surrounded by a rim of green. The deepest colour is always seen when looking down the length of the crystal, so it is important to position rough material correctly when cutting gems.

Specification

Chemical name Complex boron silicate | **Formula** $Na(Li_{1.5}Al_{1.5})Al_6(BO_3)_3[Si_6O_{18}](OH)_3(OH)$ (elbaite) | **Colours** Various
Structure Trigonal | **Hardness** 7–7.5 | **SG** 2.8–3.3
RI 1.61–1.67 | **Lustre** Vitreous | **Streak** White

Locations
1 USA **2** Brazil **3** Czech Republic **4** Italy **5** Nigeria
6 Namibia **7** South-eastern Africa **8** Madagascar
9 Afghanistan **10** Pakistan **11** Sri Lanka **12** Australia

Key pieces

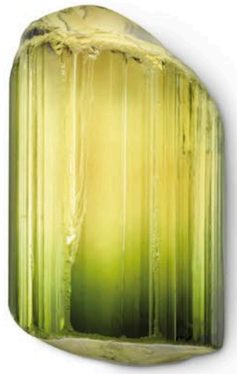
Gold and tourmaline necklace | This 18-karat gold necklace is set with pear-shaped tourmalines weighing a total of approximately 100 carats, accented with brilliant-cut diamonds.

Tiffany brooch | Created for Tiffany & Co. by Jean Schlumberger, this 18-karat textured gold salamander brooch is set with rectangular-cut green tourmalines, diamond feet, and turquoise cabochon eyes.

Cartier earrings | These fanciful orchid earrings, set in 18-karat gold, are studded with faceted pink tourmalines, pink sapphires, rhodolite garnets, and 24 diamonds. A single briolette-cut rose quartz drop completes the earrings.

Rough

Varieties



Yellow-gren rough | Yellow-green is the most common tourmaline colour, although the above piece of facet rough is slightly more yellow than most.

Achroite | Achroite is the colour-name given to colourless tourmaline, seen here shaped as a 12.24-carat, rectangular, brilliant-cut cushion.

Indicolite tourmaline | Blue tourmaline is called indicolite. This flawless 7.79-carat indicolite gem is faceted as a hexagonal mixed cut.

Paraiba tourmaline | Paraiba tourmaline is relatively new to the gem market. It contains copper and has a "neon" look. A green example is shown here.

Indicolite rough | Blue is a less common colour for tourmaline and is called indicolite. It can vary from light to deep blue in hue. This piece of rough has particularly good colour.

Dravite tourmaline | Dravite is brown tourmaline, and is not common in facet-grade material. This cushion mixed-cut dravite is particularly fine.

Rubellite tourmaline | Red or pink-red tourmaline is called rubellite. Shades range from pale pink to shocking red. This emerald step-cut rubellite shows classic colour.

Yellow-green tourmaline | Strangely, there is no colour-name for yellow-green tourmaline, although this example, shaped in a trillion cut, is a fine gem.

Colour zoning | Tourmaline can have concentric colour-zoning. When the centre is pink and the outer is green, as here, it is called watermelon tourmaline.

Yellow-green tourmaline | With its colour tending more towards green than yellow, this 4.20-carat, brilliant-cut gem has a few natural flaws.

Watermelon tourmaline | Occasionally a piece of watermelon tourmaline, such as this emerald-cut stone, is wide enough for a gem to be faceted across the colour zoning.

Schorl tourmaline | Schorl is black tourmaline and always opaque. Of all the tourmalines, it is the most common. It is shown here as tumble polished.

Settings

Bulgari Cerchi earrings | This striking pair of 18-karat gold earrings is set with green tourmaline, peridot, blue topaz, rhodolite garnet, citrine, and diamonds.

Lizard brooch | One of Cartier's animal-inspired pieces, this brooch is based around a 13.71-carat cat's eye tourmaline. It is also set with sapphires and diamonds.

Yellow gold earrings | These beautiful earrings are based around a pair of deep red tourmalines with oval cuts. They are set in yellow gold with cut diamonds.

Gold ring | This unusually set 19-karat gold ring features a custom-cut, triangular-section, bezel-mounted pale pink tourmaline cabochon.

Cartier necklace | This intricate 18-karat pink gold Paris Nouvelle Vague necklace is set with pastel-coloured stones, including 15 tourmalines, 14 aquamarines, 12 amethysts, nine spinels, and 27 brilliant-cut diamonds.

Bulgari bracelet | Made by the House of Bulgari, this extravagant bracelet is set with diamonds, cabochon emeralds, rubies, amethysts, and pink tourmalines.

Arts and Crafts brooch | Created in 1912 by Georgie and Arthur Gaskin, this brooch is set with blue opal, pink tourmaline, silver, and gold.

> The chemistry of [tourmaline] is more like a medieval doctor's prescription than the making of a respectable mineral

John **Ruskin**
Artist and art critic

Crown of the Andes | c.1590s | 34.5cm (13½in) tall, 52cm (20½in) circumference; 2.18kg (4¾lbs); Atahualpa Emerald: 15.8 x 16.15mm (½ x ¾in) | 18–22-karat gold, over 450 emeralds

Crown of the Andes

△ **Atahualpa Emerald**, the crown's centrepiece

The Crown of the Andes is a spectacular religious object, featuring the the oldest collection of emeralds on a single artefact in the world. It was fashioned by Spanish craftsmen in the 16th century in Popayán (in present-day Colombia). When the conquistadors came to plunder Inca gold, they brought with them European diseases, and in 1590 a virulent strain of smallpox swept through the region. The faithful of Popayán prayed to the Virgin for deliverance and, miraculously, they were spared. In gratitude, they decided to create a fabulous crown for the statue of the Virgin in their cathedral.

Atahualpa, the last Inca emperor and guardian of the Atahualpa Emerald

The oldest parts of the crown are the orb and cross at the top. The rest was added, year by year, with donations from the congregation. The centrepiece is the Atahualpa Emerald, named after the last of the Inca emperors and reputedly seized after his defeat by the Spanish conquistador Francisco Pizarro. The crown was displayed once a year during the majestic processions in Holy Week, but word of its splendour soon spread, and so, to protect it from treasure hunters, the church set up a clandestine group of local nobles called the Confraternity of the Immaculate Conception. At the first sign of trouble, its members were entrusted with dismantling the crown and hiding the sections in the jungle.

The group kept the crown safe until 1936, when the local clergy sold it to pay for a new hospital and orphanage. The buyers were a syndicate of American gem dealers, who wanted to break up the crown and sell its jewels. However, it proved such a popular attraction, including at the 1939 World's Fair, that this decision was reversed. It is now displayed intact at the Metropolitan Museum of Art, New York, USA.

Virgin Mary, shown here in a Peruvian painting, c.1680, was an important figure in post-conquest, early Christian religious life in the Andes

Key dates

1532–2015

1500

1532 Francisco Pizarro captures Atahualpa, the ruler of the Incas, and seizes the Atahualpa Emerald

1550

1590 Citizens of Popayán pray to the Virgin for help when an epidemic sweeps through the region

1593 Twenty-four goldsmiths begin work on the crown

1600

1599 The statue of the Virgin in Popayán Cathedral is "crowned"

Simón Bolívar, 19th-century Venezuelan leader

1650 English privateers briefly seize the crown, but it is recovered after bloody street fighting

1700

c.1770 The final sections – the intersecting arches – are added to the crown

1800

1812 Simón Bolívar captures the crown, but returns it to Popayán

1914 Pope Pius X grants permission for the sale of the crown

1900

1936 The crown is sold to a syndicate of American dealers

1939 The crown is exhibited at the New York World's Fair

2000

2015 The crown is sold to the Metropolitan Museum of Art, New York

> [The crown is] **extraordinary** for its **rarity** and its **richness**
>
> Ronda **Kasl**
> Curator, Metropolitan Museum of Art

Emerald

△ **Emerald stone** featuring the signature emerald cut

One of the most desirable gemstones, emeralds are the rich green variety of beryl, the mineral found in igneous, metamorphic, and sedimentary rocks. Most emeralds have numerous inclusions and internal flaws, and these imperfections are unique to each stone. For jewellery, the brittle gem is usually faceted in its signature emerald cut. This is a step, or trap, cut, which combines a rectangular shape with shortened corner facets, maximizing the emerald's distinctive green colour, and protecting it from external damage and internal stress.

Specification

Chemical name Aluminium beryllium silicate | **Formula** $Be_3Al_2(SiO_3)_6$ | **Colours** Emerald-green to green, yellow-green to blue | **Structure** Hexagonal | **Hardness** 7.5–8 | **SG** 2.7–2.8 | **RI** 1.565–1.602 | **Lustre** Vitreous | **Streak** White **Locations** Colombia, Zambia, Brazil, Zimbabwe

Rough

Columbia emerald | This finely formed, richly coloured, hexagonal emerald crystal is the size of a walnut. It originates from Santa Fe de Bogota, Columbia.

Emerald rough | The reddish staining on this specimen of emerald rough follows the lines of internal cracks, helping the cutter to assess its suitability.

Cut

Extra face | The cutter of this octagonal, step-cut emerald has added an extra pavilion facet to aid the removal of a particularly bad internal flaw.

Synthetic emerald | This synthetic pendeloque specimen has the same crystal structure as a natural emerald but can be purchased at a much lower price.

Emerald cut | Despite being relatively flawed, this octagonal emerald has been specifically shaped and cut in the signature style to minimize loss.

Settings

Ballerina | This beautiful ballerina clip in white gold, with a skirt of emeralds fringed with diamonds, was made by the famous jewellers Van Cleef & Arpels.

Emerald cross | This stunning white gold cross is set with 11 emeralds weighing 24 carats in total, surrounded by diamonds and demantoid garnets.

The Hooker Emerald | At 75.47 carats, this emerald is one of the largest known. Bought by Tiffany & Co. in 1911, it was initially set in a tiara, and then in this platinum brooch setting.

Iconic mascot | Produced by Cartier in 1914, this white gold panther ring set with emeralds and 545 brilliant-cut diamonds has become a design classic.

When **pure,** beryl is colourless. Traces of **chromium or vanadium** in the mineral cause it to develop a green colour and become an **emerald**

Painting of Persian ruler Nadir Shah, c.1740 | Intended recipient of the Topkapi dagger

△ **Sultan Mahmud I**, who commissioned the dagger

Topkapi emerald dagger

This celebrated emerald dagger is the star attraction of the Topkapi Palace Museum in Istanbul, Turkey. It is one of the finest objects of its kind, but its origins are inextricably linked with bloodshed and treachery.

It was made in Istanbul in the mid-18th century by the royal craftsmen of the Ottoman ruler, Sultan Mahmud I, most likely as a diplomatic gift for the Persian leader, Nadir Shah. Later known as "the Napoleon of Persia", Nadir Shah was the most powerful military figure in the region, and he had recently waged a bitter war against the Ottomans.

The two countries made peace in 1746 and exchanged gifts. Mahmud's contribution included the spectacular dagger. This was a shrewd choice, as Nadir's fondness for jewels was well known – he had seized many during his campaigns in India, including the Koh-i-noor diamond (see pp.58–59).

The Topkapi dagger, comprising gold set with emeralds and diamonds

The dagger is dominated by the huge emeralds in its handle. In the Islamic world, emeralds were highly prized and exotic – these are thought to originate from the Muzo mines in Colombia. The main upper and lower emeralds are pear-shaped, while the middle one has a rectangular cushion cut. Another octagonal emerald on top of the handle lifts to reveal a watch. The handle and sheath consist of gold set with diamonds, with enamel and mother-of-pearl decoration.

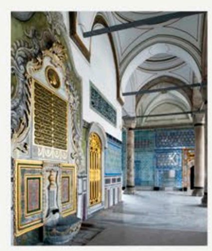
Nadir Shah never lived to see the dagger: while the gifts were in transit, he was assassinated in his bed. Upon hearing the news, the escort party returned home and the dagger was placed in Topkapi Palace, where it is still on display. Its popularity grew in 1964, when the heist film *Topkapi* depicted a fictitious plot to steal the dagger, winning actor Peter Ustinov an Oscar.

Key dates

1739–1964

- **1739** Nadir Shah carries off the Koh-i-noor diamond to Persia
- **1743–46** Persia is at war with the Ottoman Empire
- **1746** After the peace treaty is signed in September, Nadir Shah sends lavish gifts to Mahmud I
- **1747** In May, Sultan Mahmud I reciprocates by sending the dagger and other gifts to Nadir Shah
- **1747** Nadir Shah is assassinated on 20 June by members of his own guard
- **1924** The Topkapi Palace is converted into a museum
- **1964** The dagger is central to the plot of the Hollywood film *Topkapi*, which was based on a novel by Eric Ambler

Poster for the film featuring the dagger



Topkapi Palace, where the dagger is still displayed

The emerald-set cover at the top of the handle opens to reveal a gold watch

… the famous Istanbul dagger contains the four world's most priceless emeralds

Topkapi film
1964

Ancient Egyptian civilizations regarded emeralds as a symbol of life and fertility

Pendant | This 19th-century Spanish pendant is in the form of a hippocamp with a female figure. The body is set with cabochon emeralds and hangs from a chain with four pearls. The cartouche is set with an emerald and a suspended pearl.

Beryl

△ **Fine, octagonal step-cut aquamarine** with excellent clarity

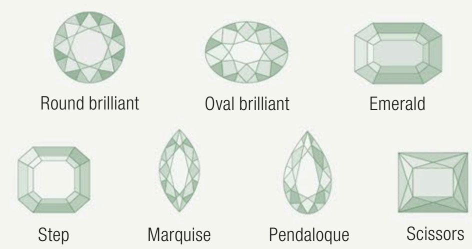
Beryl provides some of nature's most beautiful gemstones. Although it is colourless in its pure form, it is perhaps best known for its coloured varieties, which include aquamarine and emerald – indeed, its name comes from the Greek *beryllos*, meaning "green stone". The colourless form of beryl is known as goshenite, and its clarity is such that it was used to make lenses for some of the earliest eyeglasses during the late Middle Ages.

The colours of beryl

Where colours do occur in beryl, they are caused by minute chemical impurities, and this is sometimes reflected in the varieties' names. The green colour of emerald, for example, is caused by traces of chromium. Morganite is coloured pink, rose lilac, peach, orange, or pinkish yellow by the presence of manganese, and its crystals sometimes show colour banding, with a sequence from blue near the base to nearly colourless in the centre, to peach or pink at the tip. It is almost always faceted, and stones with a yellow or orange tinge are sometimes heat-treated to emphasize their pink tones. Manganese is also the colouring agent in the rare red beryl, sometimes called red emerald or scarlet emerald. The colours in blue and green aquamarine (meaning "sea water"), and yellow to golden heliodor (from the Greek *helios*, meaning "sun"), result from traces of iron. Much greenish-blue aquamarine is heated to produce an intense blue colour that has become popular in modern jewellery.

Specification

Chemical name Beryllium aluminium silicate | **Formula** $Be_3Al_2Si_6O_{18}$ | **Colours** Colourless, red, blue, green, yellow | **Structure** Hexagonal | **Hardness** 7.5–8 | **SG** 2.6–2.8 | **RI** 1.57–1.60 | **Lustre** Vitreous | **Streak** White



Locations
1 USA **2** Colombia **3** Brazil **4** Ireland **5** Norway **6** Sweden **7** Germany **8** Austria **9** South Africa **10** Zambia **11** Mozambique **12** Madagascar **13** Russia

Key pieces

Fabergé egg | This fabulous egg was made by Carl Fabergé (see pp.278–79). It is crafted from gold, platinum, and silver, and is set with aquamarines and diamonds and holds a gold model of a cruiser.

Cartier clip brooch | Designed by Cartier in 1935, the platinum and diamond setting of this clip brooch holds an unusual late 17th-century or early 18th-century Indian carved emerald in the form of a flower.

Aquamarine brooch | Made in 1967 by British jeweller and goldsmith John Donald, this gold brooch features an unusually cut aquamarine – part faceted, part cabochon. The stone is ringed with a gold setting consisting of sections of tubing.

Rough

Prismatic crystals | This outstanding mineral specimen displays numerous prismatic aquamarine crystals on a rock groundmass.

Aquamarine crystal | In general, beryl crystals of all colours tend to have fairly flat terminations, so the end faces on this crystal are unusually large.

Classic crystal | Still retaining some of its host rock at the base, this gem-quality aquamarine crystal has a classic prismatic form, with flat end faces.

Goshenite crystal | This blocky, hexagonal goshenite crystal shows good clarity, a typically colourless interior, and a fine geometric form.

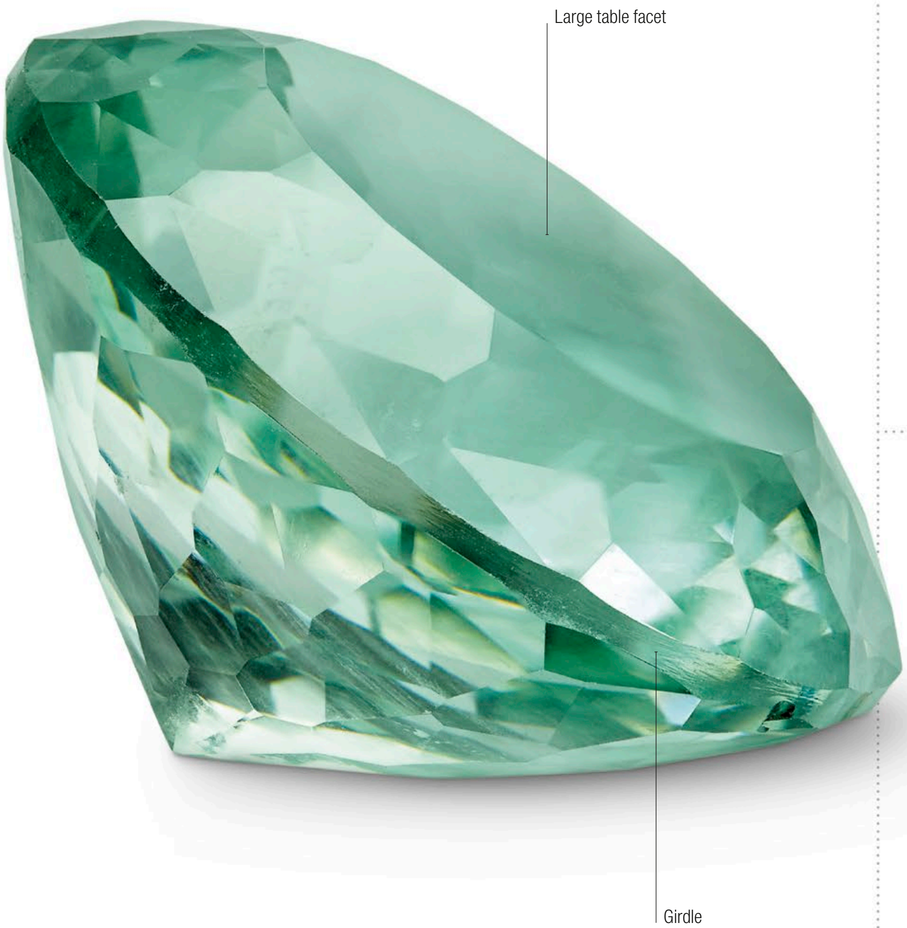
Red beryl | Red beryl is scarce in cut stones, since its crystals are both rare and small. This crystal from Utah, USA, rests on a groundmass of rhyolite.

Morganite crystal | Morganite is the pink variety of beryl. Like the other beryls, it forms fine, well developed crystals such as this specimen.

Emerald crystal | This large and fine emerald crystal exhibits classic hexagonal form and emerald-green colour. It is approximately the size of a walnut.

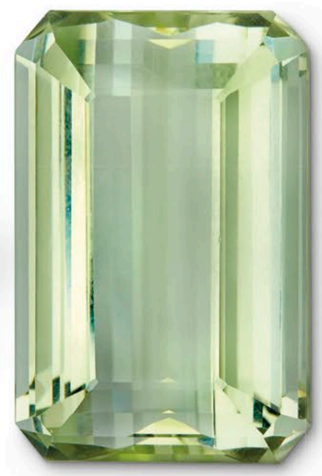
Heliodor | The yellow variety of beryl is called heliodor. The stunning clarity of this crystal is evidenced by its rock groundmass, which is clearly visible through it.

Cuts and colours

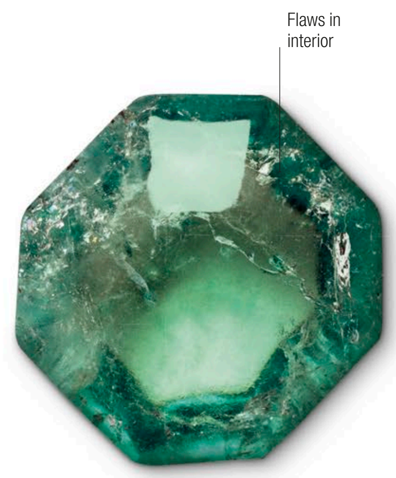


Faceted aquamarine | Certain non-standard cuts are used on large stones to enhance brilliance. The cut of this substantial 25.70-carat aquamarine stone is known as a "Portuguese" cut.

Specimens of Brazilian morganite crystal have reached up to 25kg (55lb) in weight



Emerald-cut aquamarine | Aquamarine can have either blue or green colouring, as seen in this ethereal, pale green stone with an emerald cut.



Emerald | This octagonal emerald is cut with a combination of cabochon rounding and flat facets. It is designed to emphasize the centre of the stone – the area with the fewest flaws.

Faceted heliodor | The cutter of this square-cushion heliodor has used a mixture of facet styles to emphasize both its colour and its brilliance.

Goshenite | This fine goshenite gemstone features a modified emerald cut. It is completely colourless, although such stones can appear blue when photographed.

Morganite | The delicate pink of this morganite gem is one of the lighter shades of the material, which usually occurs in rose-pink to red-pink hues.

Red beryl | This red beryl is approximately 1 carat in weight, but is still relatively large for this very rare gemstone. It is brilliant-cut and has only a few inclusions.

Settings

Multi-gem necklace | This lavish white gold necklace is highlighted with faceted stones of beryl, aquamarine, peridot, and diamond. Its diamond-set links have been crafted to resemble crossed strands.

Beryl and amethyst earrings | Faceted stones of amethyst and golden beryl are set in white gold in these cheerful earrings by Colleen B. Rosenblat. The golden beryls have a combined weight of 7.15 carats.

Paris Nouvelle Vague necklace | Set in 18-karat gold, this necklace features a cartouche of morganite suspending strands of pearls and 66 faceted spinels.

Ear pendants | Intricately crafted in silver and gold, these triangular ear pendants are set with morganites, rubies, and diamonds.

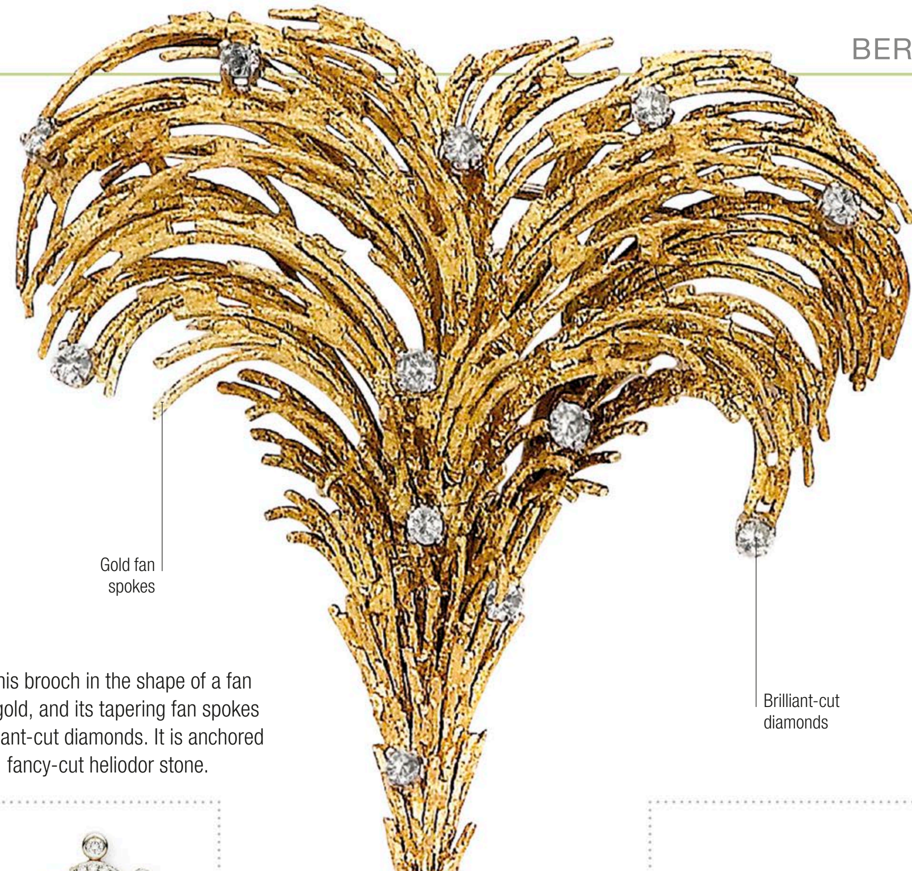
Blue tassle necklace | In an unusual display, faceted aquamarines cascade from a gold cone set with round aquamarines and champagne diamonds.

Green beryl ring | This ring is set with a light green octagonal-cut beryl weighing 22.35 carats, flanked on each side by five brilliant-cut diamonds.

Aquamarine earrings | This pair of 18-karat yellow gold earrings features four cabochon aquamarines, 28 oval sapphires, and 38 brilliant-cut diamonds.

Maximilian Emerald | The 21.04-carat emerald displayed in this modern platinum ring setting was once set in a ring belonging to Hapsburg Emperor of Mexico Maximilian.

Ring | Set with a cusion-cut morganite in its centre, this gold ring is also decorated with pearls and spinels of increasing sizes in a spray formation.




Stunning brooch | This brooch in the shape of a fan is crafted in 18-karat gold, and its tapering fan spokes are accented with brilliant-cut diamonds. It is anchored by a large, detachable, fancy-cut heliodor stone.

Golden beryl ring | Mounted on a platinum band, this large ring showcases a 28.15-carat golden beryl that has been faceted in an emerald cut.

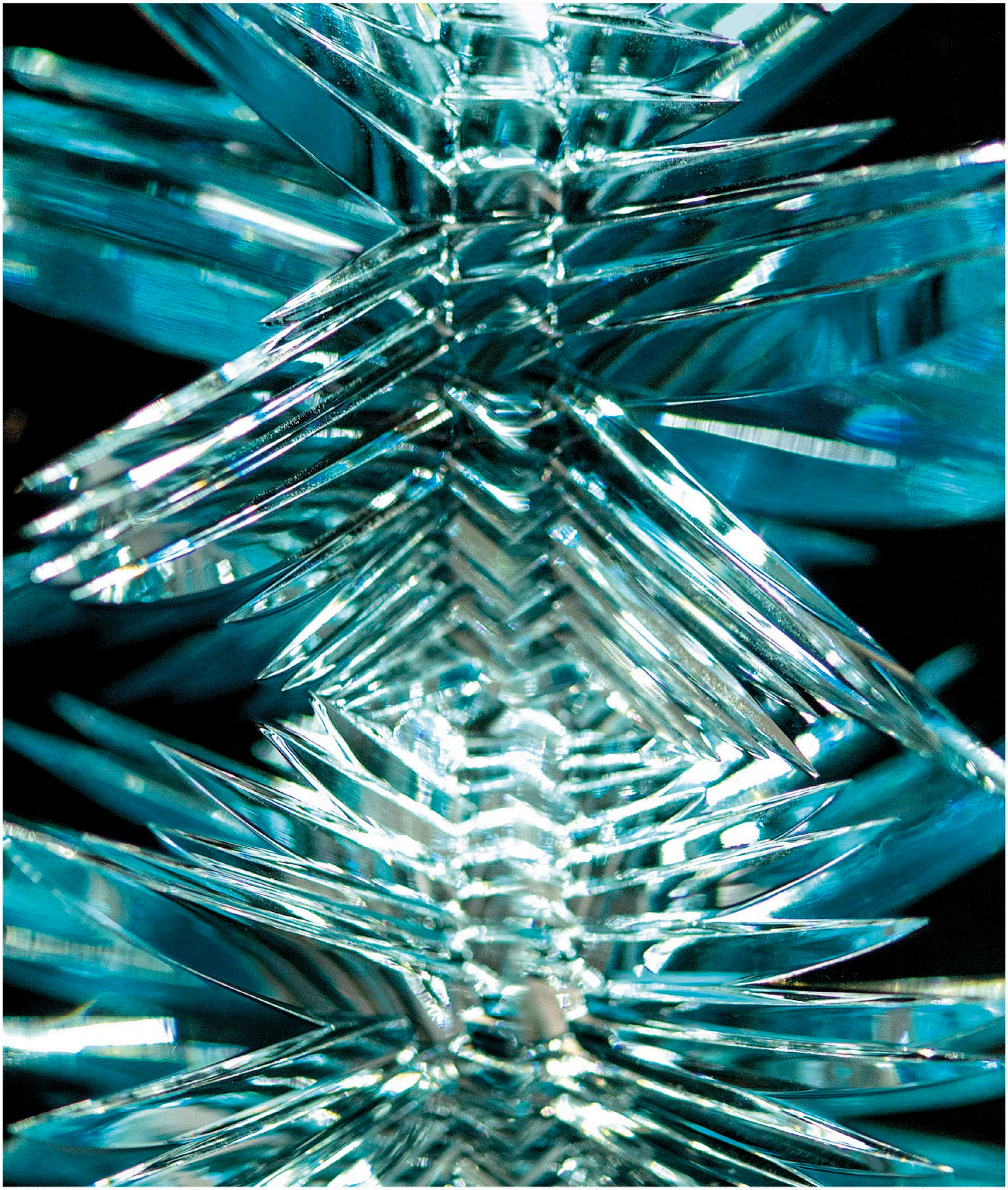
Golden beryl earrings | Created in 18-karat gold, these scrolling earrings are set with diamonds, and suspend drops of golden beryl weighing around 8 carats each.

Aquamarine and diamond ring | This stunning ring in 14-karat white gold has a central aquamarine weighing 7.32 carats, surrounded by 2.20 carats of diamonds.

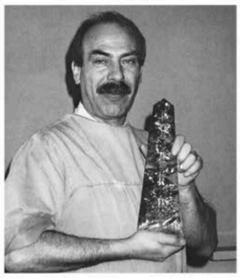
Parrot brooch | From the Cartier Flora and Fauna collection, this diamond-set parrot brooch surmounts a tourmaline gem. The parrot also features emerald "eyes"

Beryl earrings | These earrings, made around 1940, can also be worn as dress clips. They are set with diamonds, rubies, and a pair of rectangular-cut yellow beryls.

The mineral **beryl** is the **source** of one of the **modern world's** most **important** metals – **beryllium**



Dom Pedro Aquamarine | 1980s | 35cm (13¾in) tall; 10cm (4in) across the base | 10,363 carats, obelisk form



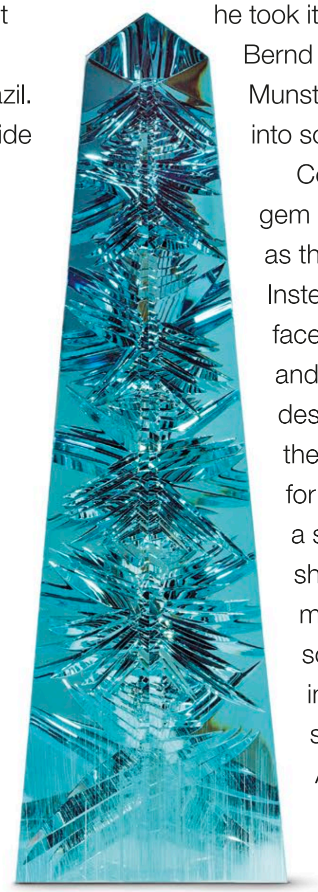
△ **Gem artist** Bernd Munsteiner, who cut the gem

Dom Pedro Aquamarine

The Dom Pedro is the largest known aquamarine gem in the world. It was fashioned out of an enormous crystal, discovered by three *garimpeiros* (independent prospectors) at Pedra Azul, in the Minas Gerais mining region of Brazil. Before the *garimpeiros* could decide what to do with it, however, they dropped it and the crystal broke into three pieces. The largest of these – which was around 60cm (2ft) in length and weighed about 27kg (60lb) – was eventually transformed into the Dom Pedro.

From the outset, there was a battle to preserve the crystal. In purely commercial terms, the most profitable outcome would have been to cut it up into small gems to be sold off, and this was the intention of the original Brazilian owner. However, the crystal came to the notice of Jürgen Henn, a German gem dealer. Immediately struck by the exceptional size, clarity, and colour of the piece, he organized a consortium of investors to purchase the crystal and transport it to Idar-Oberstein, a famous gem-cutting centre in southern Germany. There, he took it to his friend, the gem artist Bernd Munsteiner, knowing that Munsteiner could turn the crystal into something truly remarkable.

Coming from a long line of gem cutters, Munsteiner is known as the "father of the fantasy cut". Instead of using traditional flat facets, he incorporates grooves and cleverly curved facets into his designs. Munsteiner worked on the aquamarine crystal by hand for more than six months, making a series of tapering, lozenge-shaped cuts. The result is this magnificent, obelisk-like gem sculpture that reflects the light in such a way that it almost seems to glow from within. As a tribute to its Brazilian origins, he named it the Dom Pedro, after the country's two emperors who ruled during the 19th cenury.



Full view of the Dom Pedro Aquamarine

What Mother Nature has made large and beautiful, we should not make small

Jürgen **Henn**
Gem dealer

Key dates

1822–2012

- **1822** Dom Pedro I (1798–1834) becomes the first emperor of Brazil
- 1800
- **1841** Dom Pedro II (1825–91) is crowned as the second and final emperor of Brazil

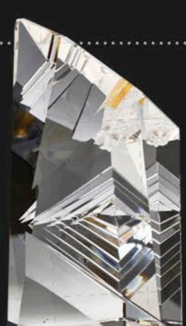
Dom Pedro I

- 1960
- **1960s** Bernd Munsteiner pioneers the "fantasy cut", a radically new form of gemstone carving
- 1980
- **Late 1980s** Three prospectors unearth a huge aquamarine crystal in Pedra Azul, Brazil
- 1990
- **1991** A German gem dealer, Jürgen Henn, examines the crystal and photographs it
- **1992** A consortium organises the purchase of the crystal and transports it to Germany
- **1992–93** In "the project of his life", Bernd Munsteiner transforms the crystal into a spectacular obelisk
- **1993** The Dom Pedro is revealed to the public at a gem fair in Basel, Switzerland
- 1995
- **1996** Jane Mitchell brings the obelisk to the US, exhibiting it at Palm Beach
- **1999** Jane Mitchell and Jeffery Bland purchase the Dom Pedro
- 2000
- 2010
- **2011** The obelisk is donated to the Smithsonian Institution, in Washington, DC, USA
- **2012** The Dom Pedro is placed on permanent display in the National Gem Collection Gallery at the Smithsonian
- 2015

Modern carving and **engraving**

Carving a gem is a step on from faceting it – it involves cutting it into a three-dimensional shape. Gems can also be engraved by incising decorative lines. The first task is to select a rough gem that is of high quality and large enough to withstand the loss of material during carving. Carved gems can be sculptures in their own right or turned into jewellery.

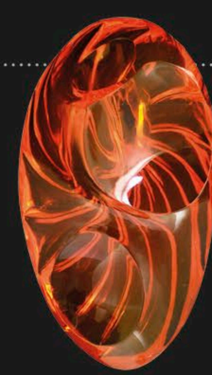
Rock crystal flaçon
This amethyst and gold stopper was made by Tom Munsteiner, son of Bernd Munsteiner (see p.243).



Sign scuplture
Gem artist Tom Munsteiner also created this bold rock crystal sculpture.

Summer Snow earrings
These carved earrings by Alice Cicolini consist of gold, pavé diamonds, amethyst, rock crystal, and rose quartz.

Tourmaline ring
This Munsteiner ring is based around a carved 9.11-carat tourmaline. It is set in yellow gold.



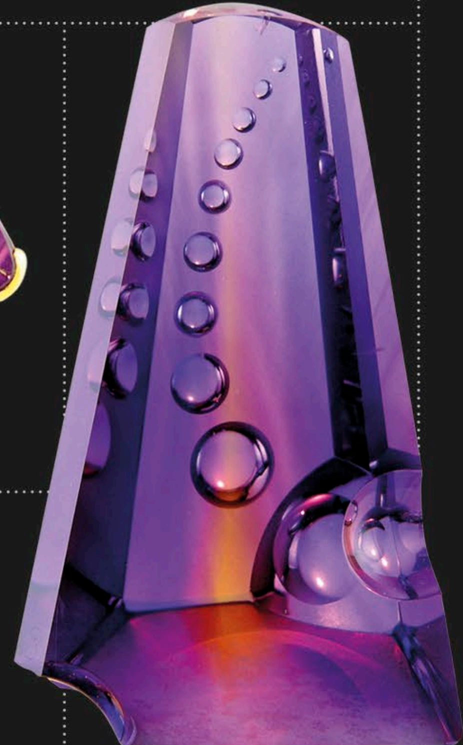
Vortex Mexican opal
This gem sculpture by Michael Dyber is a 299.45-carat opal in a flowing, free-form cut.

Palm sculpture
This piece is cut in Bolivian ametrine, weighing 287.68 carats and featuring a mixture of geometric and organic shapes.

Pushkar ring
This Cartier ring showcases carved mandarin and tsavorite garnets, tanzanites, opal cabochons, and brilliant-cut diamonds.

Southwest Sunset
Utilizing two gems naturally occurring together, this 443-carat piece by Sherris Cottier Shank consists of carved ametrine in rose quartz.

18-karat gold pin
Carved from distinctively coloured Bolivian ametrine, this pin is set in gold and studded with diamonds.



Obelisk
This Dyber ametrine obelisk features optical illusions carved on its front and back, using the refractive qualities of the material.

Danburite

△ **Transparent**, single crystal of danburite

Danburite crystals are glassy prisms that resemble topaz, but in roughs they are distinguishable by their poor cleavage. Danburite is named after the city of Danbury, Connecticut, in the USA, where it was first discovered as a distinct species in 1839. It is usually colourless, but it can also be amber, yellow, grey, pink, or yellow-brown. Danburite is cut as a gemstone, both faceted and *en cabochon*, but is generally considered a collector's stone. Large gem danburites have been found in Dalnegorsk, Russia, in crystals up to 30cm (12in) long.

Specification

Chemical name Calcium borosilicate | **Formula** $CaB_2Si_2O_8$
Colours Colourless, yellow, pink, yellow-brown | **Structure** Orthorhombic | **Hardness** 7–7.5 | **SG** 3 | **RI** 1.63–1.64
Lustre Vitreous to greasy | **Streak** White | **Locations** Switzerland, Russia, Myanmar, Slovakia, USA, Mexico, Madagascar

Yellow rough | **Rough** | This stream-rounded rough weighs around 23 carats. It comes from Tanzania, where a large amount of yellow material has been found.

Mexican danburite | **Rough** | These white crystals from San Luis Potosi, Mexico, are in parallel growth and show perfect prismatic form and classic terminations.

Fancy cut | **Cut** | This superbly faceted 15-carat heart shows fine clarity and brilliance, and has been expertly cut to enhance its natural features.

The Danbury mineral zone

A New England gem belt

The small town of Danbury, in Fairfax County, Connecticut, USA, is the centre of a local mineral belt running for several kilometres, which has produced over 50 different mineral types. It is an area of complex geological structure, with folding, faulting, and metamorphism, resulting in its rich mineralogy. As well as producing danburite, the area has also been an important source of zircon, baryte, celestine, moonstone, sphene, diopside, rutile, garnet, quartz, and pyrite.

Danburite crystal The Connecticut town of Danbury lends its name to the mineral that was discovered there.

Round brilliant | **Cut** | Danburite often rivals topaz in its brilliance and clarity, as can be seen in this flawless, round brilliant-cut gemstone.

Mixed earrings | **Set** | This earring set's pair of faceted danburites from Mexico contrasts with its pink tourmaline cabochons from Myanmar.

Axinite

△ **Emerald-cut axinite** from Mexico

Axinite refers to a group of four minerals, which in rough form are virtually indistinguishable and are structurally identical. The name derives from the Greek *axine*, meaning "axe", which refers to the sharp, hard crystals. The most common colour is clove-brown; varieties can also be grey to bluish-grey, honey-, grey-, or golden-brown; pink, violet-blue, yellow, orange, or red. Its gemstones are easily chipped, so are usually only faceted for collectors. Axinite is piezoelectric and pyroelectric, meaning it generates electricity when stressed, or rapidly heated or cooled, respectively.

Specification

Chemical name Calcium-, iron-, manganese- aluminium borosilicate | **Formula** $(Ca_2Fe, Mn, Al_2)(BSi_4O_{15})(OH)$ | **Colours** Various | **Structure** Triclinic | **Hardness** 6.5–7 | **SG** 3.2–3.3 | **RI** 1.67–1.70 | **Lustre** Vitreous | **Streak** Colourless to light brown | **Locations** USA, Russia, Australia, Mexico, France, Sri Lanka

Axinite rough | **Rough** | This facet-grade piece of axinite rough has good colour and clarity, and retains some of its original crystal form. The tabular structure is typical.

Axinite in matrix | **Rough** | This rock matrix holds a number of red-brown axinite crystals showing classic axe-head crystal forms.

Axinite crystals | **Rough** | These two crystals, each of which exhibits classic and perfect axinite form, have intergrown at one of the facial angles.

Prismatic crystal | **Rough** | Although axinite is typically found as thin, hard axe-head-shaped crystals, it can also occur in blocky form, as in this specimen.

Oval cushion | **Cut** | Although there are some natural inclusions in one end of this step-cut oval cushion, it is still a desirable gem.

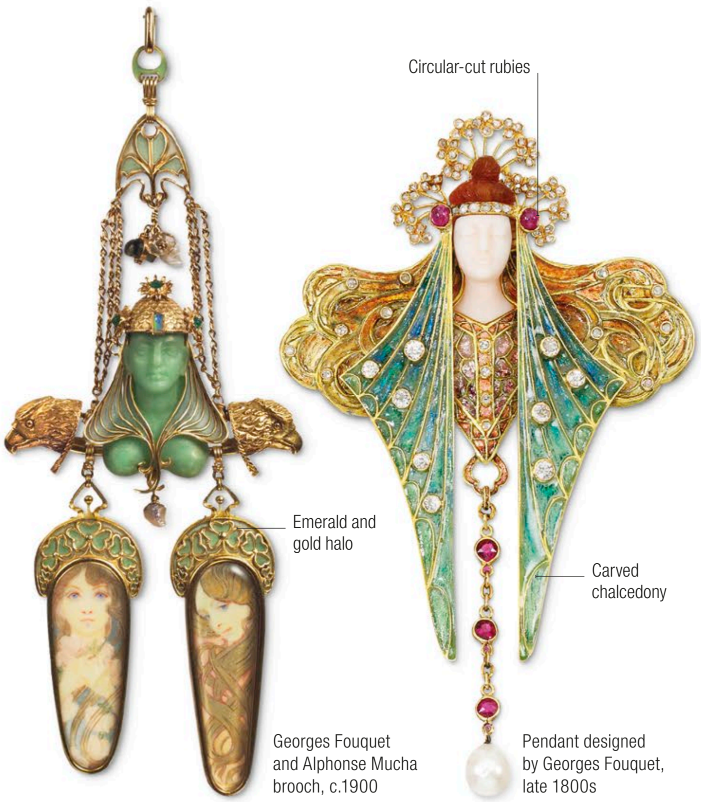
Blue oval | **Colour variety** | This oval brilliant is unusually fine both in clarity and colour: most axinite is golden- or reddish-brown, so this hue is relatively uncommon.

Mexican axinite | **Colour variety** | This cushion-cut axinite gem displays a fairly typical reddish-orange colour. It weighs 4.29 carats and has good transparency.

JEWELLERY SHOPPING

The Industrial Revolution changed the way people bought jewellery. Although many pieces were still made by hand, the spread of mass production brought jewellery within the reach of the new middle class, and many designers opened shops to sell their pieces to the general public for the first time. The Art Nouveau movement, with its focus on using gems for their pleasing aesthetics, not necessarily for their value, also helped to make jewellery more affordable.

This can be seen in the work of Parisian designer Georges Fouquet, whose spectacular store on the Rue Royale offered a luxurious shopping experience for the public. The splendid interior, created by Alphonse Mucha, harmonized perfectly with Fouquet's pieces. Jewellery was placed in bubble-shaped display cases, and Mucha skilfully weaved strong, opaque colours throughout the room to emphasize the gemstones.



Georges Fouquet and Alphonse Mucha brooch, c.1900

Pendant designed by Georges Fouquet, late 1800s

Alphonse Mucha's shop interior was a celebration of beauty within nature, with vividly-coloured stained-glass panels adorning the walls, and two spectacular peacock sculptures surveying the room. The room's curved lines and jewel-toned colours perfectly complement Fouquet's pieces.

Vesuvianite

△ **Vesuvianite** cut into a brilliant cushion

Vesuvianite is the new name for the mineral formerly called idocrase – indeed, transparent, gemstone vesuvianite is still sometimes referred to as idocrase. Its crystals are usually coloured green or chartreuse, but a number of other colours are also found. Vesuvianite can incorporate various elements in its structure; for example, an unusual bismuth-bearing vesuvianite from Långban, Sweden, is bright red; and a greenish blue, copper-bearing vesuvianite is called cyprine.

Specification

Chemical name Calcium, iron, magnesium aluminosilicate | **Formula** $Ca_{10}(Mg,Fe)_2 Al_4(SiO_4)_5(Si_2O_7)_2(OH,F)_4$ | **Colours** Yellow, brown, green, red, black, blue, purple | **Structure** Tetragonal or monoclinic **Hardness** 6.5 | **SG** 3.3–3.4 | **RI** 1.70–1.72 | **Lustre** Vitreous to resinous | **Streak** White | **Locations** Italy, Russia, USA

Vesuvianite crystals | **Rough** | This group of substantial transparent, gem-quality, yellow-green vesuvianite crystals would be suitable material for faceting.

Tumble polished | **Cut** | Vesuvianite, and vesuvianite intermixed with grossular garnet, is popular for tumble-polished stones, as in this specimen.

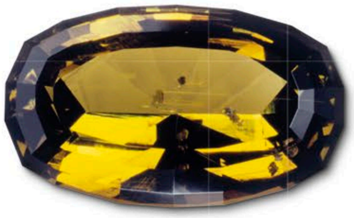
Translucent vesuvianite | **Cut** | Vesuvianite that is not quite transparent enough for faceted gems is cut into attractive cabochons, as shown here.

Vesuvianite is sold under different trade names – "californite" is massive, jade-like vesuvianite

Dark green cabochon | **Colour variety** | Vesuvianite, such as this dark green, opaque specimen, has been marketed as California jade in the past.

Necklace and earrings | **Set** | This gold necklace and earring group is set with vesuvianite cabochons, and accented by blue cabochon moonstones.

Dark brown vesuvianite | **Cut** | This dramatic stone features an emerald cut and a number of inclusions, which combine with its colour to create a brooding appearance.



Epidote

△ **Highly transparent**, step-cut, oval epidote gem

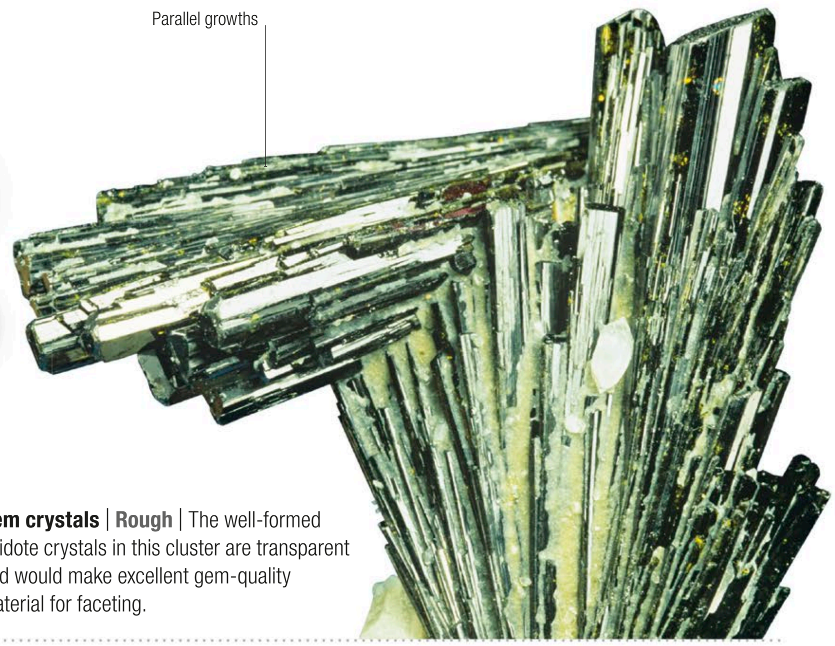
Although epidote is widespread and abundant in metamorphic and granitic rocks, it is less well known as a gemstone. It frequently forms well-developed, transparent crystals that are strongly pleochroic, usually varying in shades of green when viewed from different angles. This requires the cutter to take the orientation of an epidote crystal into consideration when faceting it. It is a fairly fragile mineral with a distinct cleavage, so faceted stones are unsuitable to be made into jewellery and are cut only for collectors.

Specification

Chemical name Calcium aluminium ferrosilicate | **Formula** $Ca_2(Fe,Al)_3(SiO_4)_3(OH)$ | **Colours** Pistachio, mottled pink and green (unakite) | **Structure** Monoclinic | **Hardness** 6–7 | **SG** 3.3–3.5 | **RI** 1.73–1.77 | **Lustre** Vitreous | **Streak** Colourless or greyish | **Locations** Myanmar, France, Norway, Peru, USA, Pakistan

Epidote in matrix | **Rough** | This elongated specimen consists of a series of long, thin epidote crystals that have grown in a quartz matrix.

Pistachio epidote | **Rough** | This cluster of long, prismatic, pistachio-green epidote crystals originates from Peru, a source of large amounts of the mineral.



Gem crystals | **Rough** | The well-formed epidote crystals in this cluster are transparent and would make excellent gem-quality material for faceting.

Mottled unakite | **Colour variety** | Rock made primarily of epidote, such as this mixture of epidote and feldspar, may be polished or tumbled and sold as unakite.

Brown epidote | **Colour variety** | Brown epidote is an uncommon colour, and is even more uncommon in faceted gems, as in this rectangular step-cut.

Unakite

A colourful variety

Unakite is an altered granite made up of pink orthoclase feldspar, green epidote, and generally colourless quartz. It is also referred to as epidotized, or epidote, granite. Found in various shades of green and pink, it is usually mottled in appearance; it takes a good polish and is thus used as beads or cabochons, and as eggs, spheres, and animal carvings. Some material called unakite lacks the feldspar and is called epidosite; this is also used as beads and cabochons.

Various beads Strands of colourful semi-precious stones hang in a shop, including those of unakite, top centre.

Kornerupine

△ **Fine, rectangular step-cut** greenish-brown kornerupine

Kornerupine is a rare borosilicate mineral, named in honour of the Danish geologist, Andreas Nicolaus Kornerup. Its crystals can resemble tourmaline prisms, and are found in shades of brown, green, and yellow all the way through to colourless; of all these, emerald-green and blue are the most highly valued. It is still relatively rare in faceted stones. When faceting, the lapidary must orient the stone carefully in order to obtain the best colour, with the table facet parallel to the prism faces of the crystal.

Specification

Chemical name Magnesium-aluminium borosilicate | **Formula** $Mg_3Al_6(Si,Al,B)_5O_{21}(OH)$ | **Colours** Green, white, blue | **Structure** Orthorhombic | **Hardness** 6.5–7 | **SG** 3.3–3.5 | **RI** 1.66–1.69 | **Lustre** Vitreous | **Streak** White | **Locations** Madagascar, Sri Lanka, Canada, Greenland, Norway, Russia

Kornerupine specimen | Rough | This small but excellent quality piece of kornerupine faceting rough originates from Mogok, Myanmar.

Kornerupine crystals | Rough | This specimen consists of a number of prismatic kornerupine crystals combined in a groundmass of rock.

Blue cabochon | Cut | Cut from a Tanzanian rough, this 4.38-carat blue cabochon contains a few internal flaws, but is still a desirable stone.

Kenyan kornerupine | Cut | This kornerupine from Kenya in an intense shade of green is far from flawless, but this is compensated by its bold emerald cut.

Kornerupine was first described and named in 1884, but nearly 30 years passed before the first gem-quality material was discovered

Scissors cut | Cut | This flawless kornerupine gemstone features a scissors cut crafted to emphasize both its clarity and its brilliance.

Oval brilliant | Cut | Kornerupine is such a rare gem that a few internal flaws such as the healed fractures within this 7.43-carat Sri Lankan stone are acceptable.

Zoisite

△ **Mixed-cut** tanzanite gemstone

The mineral name "zoisite" may not be particularly well known, but its gemstone variety, tanzanite, is popular among collectors. Found in lilac-blue to sapphire-blue colouring, it was named after its place of discovery, Tanzania. Tanzanite crystals have strong pleochroism, and show grey, purple, or blue depending on the angle from which they are viewed. Another, pink, variety is called thulite, from Thule, the name of an ancient island now thought to be Norway. Ordinary zoisite is usually massive and can be carved as a decorative stone, and as beads or cabochons.

Specification

Chemical name Calcium aluminosilicate | **Formula** $Ca_2Al_3(SiO_4)_3(OH)$ | **Colours** Blue, pink, white, light brown, green, grey | **Structure** Orthorhombic | **Hardness** 6.5–7 **SG** 3.2–3.4 | **RI** 1.69–1.70 | **Lustre** Vitreous | **Streak** White **Locations** Tanzania, Norway, Italy, Spain, Germany, Scotland, Japan

Uncut thulite | **Rough** | Displaying a light pink colour and dense texture, this piece of thulite rough would be suitable for carving or cutting into cabochons.

Tanzanite rough | **Rough** | This piece of tanzanite rough shows excellent colour and transparency, and still retains much of its original crystal form.

Thulite cabochon | **Cut** | The colour of thulite tends to be subtle and soft. This thulite cabochon cut with a low dome has a delicate pink colour.

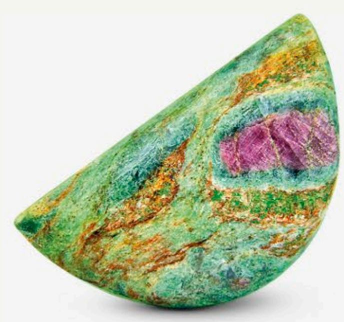
Huge tanzanite | **Cut** | Tanzanite gems over five carats are uncommon. This stunning, curved triangular brilliant-cut gem weighs 15.34 carats.

Cluster ring | **Set** | This ring features a cushion-cut tanzanite weighing 5.46 carats, encircled by a surround of brilliant-cut diamonds, with baguette diamonds on the openwork sides.

Ruby in zoisite

Naturally occurring patterns

Anyolite is the name of a brilliant green variety of zoisite sprinkled through with rubies. The bright red rubies are often distorted and irregularly spread throughout the sea of massive green zoisite, and can vary in size from a few millimeters to several centimetres. The rubies are not of gem quality, but their colour provides a striking contrast to the green zoisite. It is popular as a carving and ornamental stone, with the rubies greatly enhancing the decorative pieces carved from it.



Red on green The contrast of the bright red ruby with the green zoisite is clear in this specimen.

Peridot

△ **Polished pebble** of peridot

The name "peridot" is French, possibly derived from the Arabic word *faridat*, meaning "gem". This variety of gem-quality olivine has been mined for over 3,500 years – the Red Sea island of Zabargad (now St John's Island) was the main source of peridot for ancient Mediterranean civilizations. The Greeks and Romans called this island Topazios, and so they named this stone "topaz", although it has nothing to do with the gem of the same name. Peridot can range from pale golden-green to brownish-green in colour; rich green is the most valued of all.

Specification

Chemical name Magnesium, iron silicate | **Formula** $(Mg,Fe)_2SiO_4$ **Colours** Pale green to brownish-green | **Structure** Orthorhombic **Hardness** 6.5–7 | **SG** 3.32–3.37 | **RI** 1.64–1.69 | **Lustre** Vitreous to greasy | **Streak** White to greenish | **Locations** China, Myanmar, Norway, USA, Canary Islands, Australia, Sierra Leone

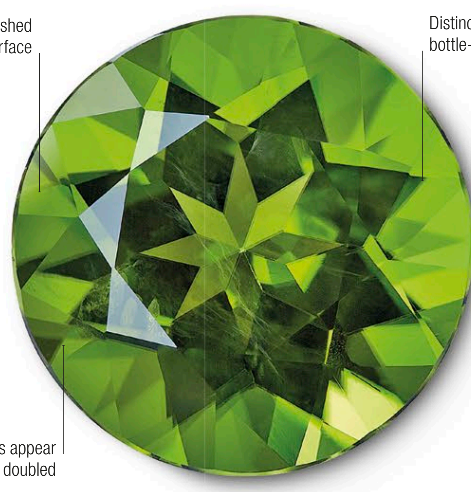
Rough

Crystal | This crystal comes from Sapat, near Naran, Pakistan, the principal source of peridot. It is usually found in dry climates or recently formed rocks.

Cut

Mixed cut | The cutter of this dark green peridot used a mixture of cuts to maximize brilliance: a scissors-cut crown and a step-cut pavilion.

Faceted teardrop | Peridot that is lighter green, as here, tends to be cut with a multitude of facets to deepen its colour and make the most of its transparency.



Faceted round cut | Because peridot is doubly refractive, the back facets of this stone appear doubled when viewed through the stone, giving great depth of colour.

Settings

Edwardian pendant | This early 20th-century gold pendant in the form of leaves and flowers is set with numerous pearls and diamonds, and features a central stone and drop of oval brilliant-cut peridots.

Signet ring | The central bezel of this striking gold ring is set with a large, bright, central peridot, surrounded by a circle of smaller diamonds.

Ring | This unusual ring makes a feature of asymmetry, with three peridot segments set off by a contrasting wedge of diamonds, encased in a gold band.

Caterpillar brooch | This quirky brooch maximizes the contrast of complementary colours, pairing coral with peridot and adding diamond eyes for good measure.

Gold pendant | Here a flawless, octagonal step-cut, bottle-green peridot is surrounded by diamonds, with a diamond-encrusted suspension loop.

The August born without this stone, 'tis said, must live unloved alone

Traditional birthstone rhyme for peridot

Necklace | Beads of peridot were threaded together into chains and then twisted to form thick, textured bands to make up this gold-clasped necklace.

Peridot and emerald

Green gemstones in history

Peridot has long been confused and compared with its famous fellow green gemstone. Cleopatra's collection of emeralds is now thought to have been peridot, and the ancient Romans described the gem as "emerald of the evening" for the way it caught the dimmest of light. For centuries, the 200-carat peridots topping the lavish shrine of the Three Holy Fathers in Cologne, Germany were also taken to be emeralds.

Shrine of the Three Holy Fathers The five huge peridots along the top of this cathedral shrine were once prized as emeralds.

Shwedagon Pagoda, Yangon, Myanmar | c.6th–10th century | Plated with gold and set with diamonds, rubies, sapphires, and other precious stones

Shwedagon **Pagoda**

△ **Statue of Buddha** at the Shwedagon Pagoda, Myanmar

The Shwedagon Pagoda in Yangon, Myanmar's capital city, is a stupa (Buddhist reliquary) that was built to house eight of the Buddha's hairs, as well as other relics. It is one of the most sacred Buddhist pagodas and, with its gold plating and precious stones, is also one of the most opulent.

The pagoda rises 99m (326ft) from a hill above the city. The lower part is covered with 8,688 gold plates and the upper part with 13,153. The top of the stupa, too high to see clearly from the ground, is set with 5,448 diamonds, a mixture of 2,317 rubies, sapphires, and other precious stones, and 1,065 golden bells. It is tipped with a huge 76-carat diamond.

The stupa dazzles in the sunshine and emits a golden glow when illuminated at night. It is traditionally said to be 2,600 years old, making it the world's oldest stupa, although evidence suggests it is more recent, possibly from around 6th–10th centuries CE. According to legend, two brothers, merchants from Balkhin (in present-day Afghanistan) met the Lord Gautama Buddha and were presented with eight of his hairs, which they later brought to Burma. With the help of local ruler King Okkalapa, they travelled to Singuttara Hill where three relics of other Buddhas preceding Gautama were also enshrined. The relics were placed in a chamber filled knee-deep with jewels, covered with a stone slab, and entombed when the stupa was built around them. Since then the pagoda has been rebuilt, ransacked, and restored, but throughout it has remained a crucial site of veneration.

Pagoda with the Great Bell of Dhammazedi in the foreground, once thought to be the largest bell in the world. The bell has since been lost in the Yangon River, Myanmar

Top of the stupa set with diamonds, rubies, sapphires, and other precious stones

> Shwe Dagon **dominates the city** physically, aesthetically and **spiritually**
>
> Win **Pe**
> Author and artist

Key dates

6th century CE–2012

- **6th–10th century CE** The pagoda is built by the Mon people, an ethnic group from Burma
- **1300s** King Binnya U rebuilds the derelict pagoda to 18m (59ft) in height
- **1400s** Queen Binnya Thau raises the pagoda to 40m (131ft), assigning land and slaves to maintain it
- **1485** King Dhammazedi donates a bell weighing 275 tonnes (300 tons)
- **1608** Portuguese adventurer Filipe de Brito e Nicote steals the bell, but it sinks into the Bago River
- **1768** An earthquake brings down the top of the stupa. King Hsinbyushin later raises it to 99m (326ft)
- **1824** Pillage and vandalism occurs during the First Anglo-Burmese War when the British occupy the Pagoda
- **1852** British reoccupy the pagoda during the Second Anglo-Burmese War
- **1946** General Aung San addresses a crowd at the stupa demanding independence from the British
- **1988** General Aung's daughter, Aung San Suu Kyi, addresses 500,000 people at the stupa, demanding democracy
- **2012** Devotees celebrate the annual Shwedagon Pagoda Festival for the first time since 1988

General Aung San, politician and revolutionary

Visigothic eagle fibulae | From 6th century CE, these two brooches found in southwest Spain are of gilt bronze and set with garnets, amethyst, and glass. They would have fastened a cloak at each shoulder.

Garnet

△ **Round, brilliant-cut** almandine garnet

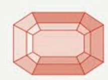
Garnets are generally thought of as red, but they can also be orange, pink, green, black, and honey-brown. All species of garnets have similar physical properties and crystal forms, but differ in chemical composition. There are over 15 garnet species, of which six varieties are most commonly used as gems: pyrope, almandite, spessartite, grossularite (includes hessonite and tsavorite), andradite (includes demantoid), and uvarovite. Although they are found in many different colours and compositions, garnets are easily recognized because they are generally found as well-developed crystals with a basic – although sometimes modified – dodecahedral form. The name "garnet" is derived from the Latin *granatus*, from granum ("grain, seed"), possibly a reference to the vivid red seed covers of the pomegranate, which are similar in shape, size, and colour to some garnet crystals.

A tradition of inlaying

The use of garnets as gemstones dates back to at least the Bronze Age. They were especially used inlaid in gold cells in the cloisonné technique, a style often just called garnet cloisonné. Many consider this the highest point of garnet work, and it can be seen in Anglo-Saxon England at Sutton Hoo and in the Staffordshire Hoard (see pp.264–65). A lesser known use of garnet is as an abrasive, used instead of silica sand in sand blasting. Garnet is used to cut steel and other materials in high-pressure water jets. Garnet sandpaper is a favourite of cabinet makers for finishing bare wood.

Specification

Chemical name (A)Ca/Fe/Mg/Mn (B)Al/Cr/Si/Ti/Zr/Vn Silicate
Formula $A_3B_2(SiO_4)_3$ | **Colours** Black, brown, yellow, green, red, violet, orange, pink | **Structure** Cubic | **Hardness** 7–7.5
SG 3.6–4.3 | **RI** 1.73–1.94 | **Lustre** Vitreous | **Streak** White


Emerald


Step

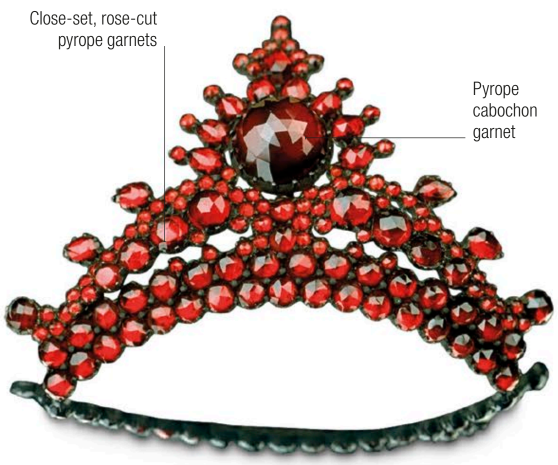

Round brilliant


Oval brilliant


Cabochon

Locations
1 Canada **2** USA **3** Mexico **4** Germany **5** Czech Republic **6** Italy **7** Namibia **8** South Africa **9** Kenya **10** Tanzania **11** Madagascar **12** Sri Lanka

Key pieces

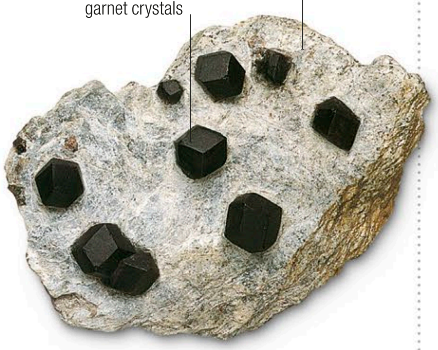


Antique hairpin | Set with pyrope garnets from Bohemia (now part of the Czech Republic), this gold hairpin was probably crafted in Victorian times. Pyrope, from the Greek *pyropos*, means "firelike".

Stork pendant | Set with a large and luxurious garnet cabochon and highlighted with baroque pearls, this gold pendant with facing storks dates from about 1900. Storks often symbolize purity and renewal.

Fabergé seahorse brooch | This seahorse wrapped in seaweed is set with green demantoid garnets, tsavorite garnets, alexandrites, tourmalines, sapphires, and diamonds.

Rough



Alamandine in matrix | This specimen has a number of classic almandine garnet dodecahedrons embedded in a groundmass of mica schist.

Melanite andradite garnet | This fine crystal of andradite garnet displays the form of a dodecahedron modified by an octahedron.

Grossular garnet | Grossular garnets tend to be pink or green, but may be found in other colours. This crystal in a groundmass is deep pink-red.

Uvarovite | Green uvarovite garnet is one of the rarest varieties of the mineral. Here, uvarovite crystals form a crust on a rock groundmass.

Hessonite garnets | Hessonite, informally referred to as “cinnamon stone”, is an orange-brown garnet and one of the varieties of grossular garnet. This specimen consists of a cluster of vividly-coloured crystals.

Varieties

Grossular brilliant | This flawless, light green grossular faceted into a classic round brilliant is cut from rough material mined in Mali.

Demantoid garnet | Demantoid means “diamond-like”, referring to brilliance. This stone is a green variety of andradite and is faceted here with an oval mixed cut.

Demantoid garnet | Faceted in a round standard brilliant, this demantoid variety of andradite has a yellowish-tinge to its otherwise green colouring.

Grossular garnet | Grossular garnets are found in a variety of colours. This example, cut in a mixed-cut cushion, is near colourless with a greenish tinge.

Green demantoid | The green of demantoid andradite garnets varies from yellow-green to the deep, rich green of this triangular fancy-cut stone.

Colour-change garnet | Discovered in Madagascar only in 1990, this garnet is a mixture of pyrope and spessartine, and shifts from blue-green to purple.

Some **Asiatic tribes** used **garnets** as **musket balls** in the belief that their **blood-red colour** would make them **more lethal**

Spessartine garnet | Sometimes mistaken for hessonite in cut stones, spessartine is less rare now than in the past, due to abundant new finds. It is shown here in a brilliant-cut oval gemstone.

Cinnamon heart | This hessonite "cinnamon stone" heart is faceted in a mixed cut, and has numerous inclusions of gas-filled bubbles, all of which have been attractively magnified by the faceting.

Hessonite garnet | Faceted in a round, mixed cut, this hessonite variety of grossular is characterised by an unusually deep and rich colouring.

Pyrope garnet | With its deep red colouring, pyrope is sometimes mistaken for ruby. This example has been faceted in a pendaloque cut.

Malaya garnet | This garnet is a mixture of pyrope and spessartine, and is often richly coloured, as can be seen in this brilliant-cut cushion gemstone.

Almandine garnet | Rich, purple-red garnets are usually regarded as the best gem-grade almandine garnets, as in this rectangular, cushion mixed-cut.

Settings

Almandine ring | The almandine garnet set in this white gold ring is faceted in an unusual chequerboard pattern, and surrounded by citrines.

Tsavorite and sapphire ring | The central stone in this 14-karat gold ring is an oval-cut tsavorite garnet, flanked by two white sapphires.

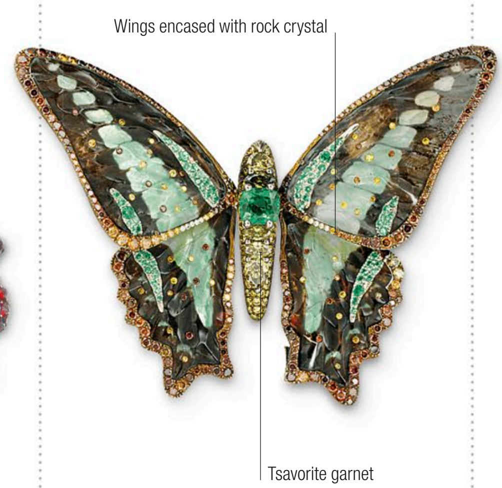
Tsavorite necklace | This spectacular necklace is composed of 14 large, pear-shaped tsavorite garnets of varying sizes with a total weight of 30.79 carats. Tsavorite is one of the rarest and most prized varieities of garnet.

Antique earrings | Made c.1890, these feature pendaloque-cut hessonite garnets suspended below cushion-cut hessonites, all circled by diamonds.

Cartier ring | This 18-karat white gold ring from the Paris Nouvelle Vague collection is set with chalcedonies, garnets, tourmaline, aquamarines, and diamonds.

Trio brooch | Designed in three clusters, each centres on an oval-cut garnet, surrounded by rubies, and with diamonds in a trefoil pattern.

Cocktail ring | Seen in close-up, this spectacular white gold cocktail ring features dozens of rose-cut garnets closely set in a floral pattern.



Butterfly clip brooch | Unusually crafted in titanium, this intricate butterfly brooch has a body set with a tsavorite garnet and yellow diamonds.

Garnet locket | Made in England in 1852, this antique locket features an intricately patterned gold heart surrounding a polished garnet cabochon.

Antique cross | This Victorian silver cross is set with 10 larger rose-cut garnets, surrounded by a number of smaller rose-cut garnets.

Rhodolite and diamond brooch | Set with blood-red, rectangular and square-cut rhodolite garnets, this striking Art-Deco brooch was made around 1930.

Belle-Epoque pendant brooch | This brooch, dating from around 1910, features a yellow sapphire surrounded by green demantoid garnets.

Demantoid crab brooch | This vivid, 18-karat gold brooch in the shape of a crab is pavé-set with demantoid garnets and features old-cut diamonds.

Hessonite and platinum ring | This platinum ring mounts an oval-cut hessonite garnet flanked by diamonds set in the form of a knot.

Cartier ring | This 18-karat gold ring from the Paris Nouvelle Vague collection, shown here from above, is set with 120 yellow garnets and yellow sapphires.

Spessatite pendant | Set in platinum, this pendant features an oval-cut spessatite surrounded by 14 round-cut diamonds, with a suspended diamond.

Bulgari watch | This 18-karat gold watch has three circles of diamonds set with amethyst, aquamarine, chrysoprase, tourmaline, and two hessonite garnets.

Staffordshire hoard | c.6th century CE | More than 5kg (11lb) of gold, 1.4kg (3lb) of silver, and 3,500 garnets | Discovered in a field in the UK near an ancient Roman road

Staffordshire hoard

△ **Gold and garnet** ornament from a larger item

Gold hilt collar from a sword, featuring detailed decoration consisting of fine gold strands wound into coils and set in knotwork patterns

One summer's day in July 2009, metal detectorist Terry Herbert set out across the Staffordshire countryside near Hammerwich, UK, with permission from local farmer Fred Johnson to search his fields. By the end of the day, Herbert had uncovered thousands of richly decorated gold and silver fragments.

Buried less than a finger's depth below the soil, the finely wrought metal pieces were later identified by archaeologists at Birmingham University as the world's largest hoard of Anglo-Saxon gold. Herbert and Johnson sold the find to museums in Birmingham and Stoke-on-Trent for £3.3 million (around US$5 million), splitting the proceeds between them. Excavation of the site in 2012 revealed another batch of fragments, bringing the total to more than 4,000 remnants of the armour, weapons, and battle dress of Anglo-Saxon men. Conservationists have assembled more than 80 sword pommels (the counterweight at the end of a sword's handle). One of the most significant items in the hoard is a silver Anglo-Saxon warrior's helmet, one of only five in Britain. Its re-creation involved assembling 1,500 scraps of silver-gilt foil, many measuring less than 1cm (around ¼in) across. The Staffordshire hoard displays an extraordinary level of craftsmanship, featuring fine threads of gold wound into tight coils and used to make swirling filigree patterns. Other pieces are inlaid with red garnet, and blue Roman and Saxon glass. Museum conservationists have dubbed the hoard "warrior bling".

Gold relic from the hoard with cloisonné and garnet decoration

Rise up, O Lord, and may thy enemies be scattered and those who hate thee be driven from thy face

Biblical **inscription**
On a silver-gilt strip in the hoard (translated from Latin)

Key dates

5th century CE–2013

400

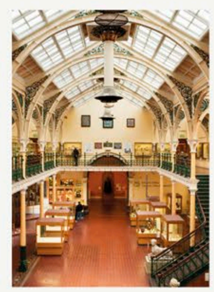
5th century CE Anglo-Saxons from north-western Europe invade Great Britain and settle

700

7th–8th centuries CE Anglo-Saxon metal workshops produce beautifully decorated military wear

Anglo-Saxon helmet, c.7th century CE

800



Birmingham Museum and Art Gallery

2000

July–August 2009 Gold and silver fragments are found by Terry Herbert near Hammerwich, England. The site is excavated by the University of Birmingham's Archaeology Department

2009

September 2009 Part of the hoard goes on display at Birmingham Museum and Art Gallery

November 2009 The hoard is sent to the British Museum

2010

January 2010 A nationwide appeal is launched to purchase the hoard for the nation

March 2010 Fundraising is completed, and the hoard is bought from Herbert and Johnson

2012

November 2012 A second batch of fragments is found close to the original site

2013 A three-year touring exhibition is launched across the West Midlands

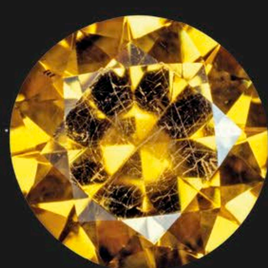
2015

Diamond RI 2.42
Cut diamonds have a very high RI and great dispersion, giving the gems their distinctive brilliance and shine.

Fire and **brilliance**

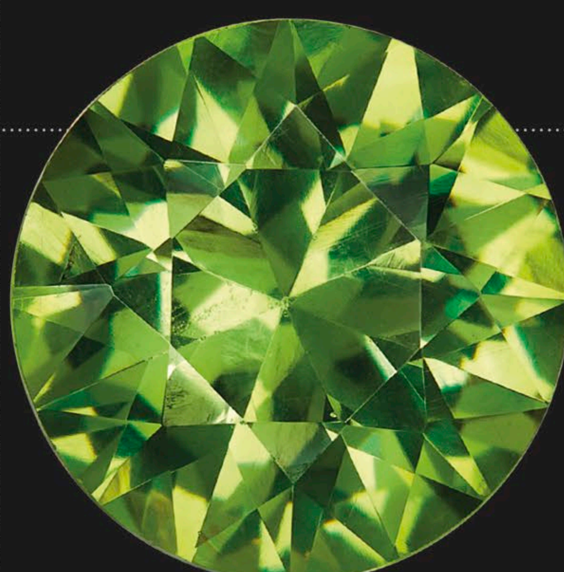
The term "fire" is used to describe the flashes of light that make a gemstone sparkle when it is moved. As with a prism, when white light enters a gem its component colours are dispersed: the greater the dispersion of white light, the greater the fire. The refractive index (RI, see p.23) is a measure of dispersion. Diamonds have high dispersion and are valued for their brilliance; however, gems with low RI can be valued for other reasons.

Sphalerite RI 2.36–2.37
Sphalerite is extremely difficult to facet, but cut stones exhibit a high RI and good fire.



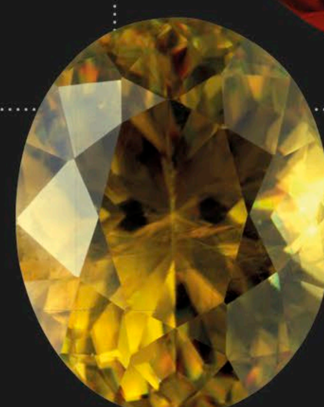
Scheelite RI 1.92–1.93
Faceted scheelite is rare. However, it exhibits good dispersion of light when cut.

Cassiterite RI 2.00–2.10
Cassiterites are dichroic, displaying different colours when moved.



Demantoid garnet RI 1.85–1.89
This variety is the most highly sought-after type of andradite garnet; it has greater colour dispersion than diamond.

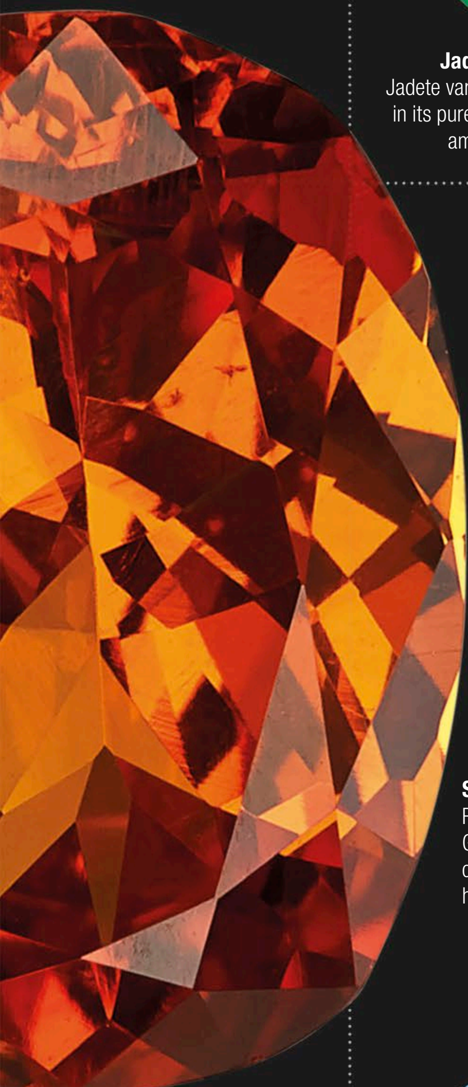
Zircon RI 1.81–2.02
Zircon's high RI and excellent dispersion come close to diamond in terms of fire and brilliance.



Sphene RI 1.84–2.11
Transparent sphene crystals, where they occur, have good fire and brilliance.

Jadeite RI 1.65–1.68
Jadete varies in colour, and is white in its pure form. It has a moderate amout of dispersion.

Chrysocolla RI 1.46–1.57
Chrysocolla is generally blue-green and massive. Its fire and brilliance are moderately low.



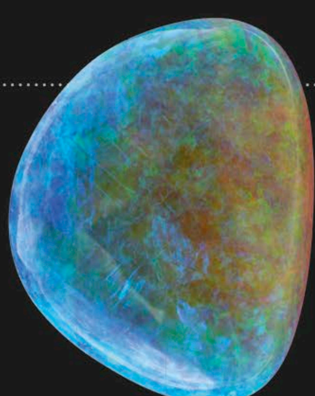
Spessartine garnet
RI 1.79–1.81
Gem-quality spessartine crystals are rare, but have good dispersion.

Ruby RI 1.76–1.78
The best ruby material has excellent brilliance, as well as its striking red colouring.

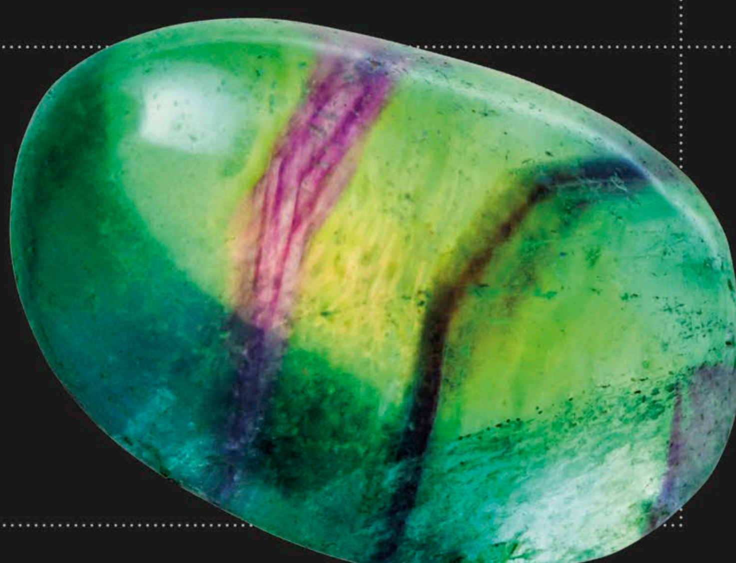
Onyx RI 1.54–1.55
Onyx can be black or brown with white colour banding, giving a fairly restrained dispersion.

Sodalite RI 1.48
Transparent sodalite is rare, and its RI is low; however, good-quality gemstones can be cut.

Obsidian RI 1.45–1.55
Despite its deep black colouring, obsidian is more refractive than some gems.



Opal RI 1.37–1.52
Opal has a distinctive colour play, which comes from diffraction caused by tiny silica spheres.



Fluorite RI 1.43
With one of the widest colour ranges of any mineral, fluorite has moderate brilliance.

Zircon

△ **Cushion-cut**, 10-carat zircon from Myanmar

Some zircon material is 4.4 billion years old, making it the oldest-known mineral on Earth. It is a colourful gem with high refraction and fire. Colourless zircon is known for its luminescence and reflective flashes of multicoloured light, and is often used in jewellery as a substitute for diamonds. Vibrant blue zircons are produced by heat-treating the more common brown stones. The mineral sometimes contains traces of uranium and thorium, and this natural radioactivity can disrupt the crystal structure, causing changes to colour, density, RI, and double refraction.

Specification

Chemical name Zirconium silicate | **Formula** $ZrSiO_4$
Colours Reddish brown, yellow, green, blue, grey, colourless
Structure Tetragonal | **Hardness** 6.5–7.5 | **SG** 3.9–4.7
RI 1.81–2.02 | **Lustre** Vitreous to brilliant sheen | **Streak** White | **Locations** Australia, Myanmar, Cambodia, Tanzania

Rough

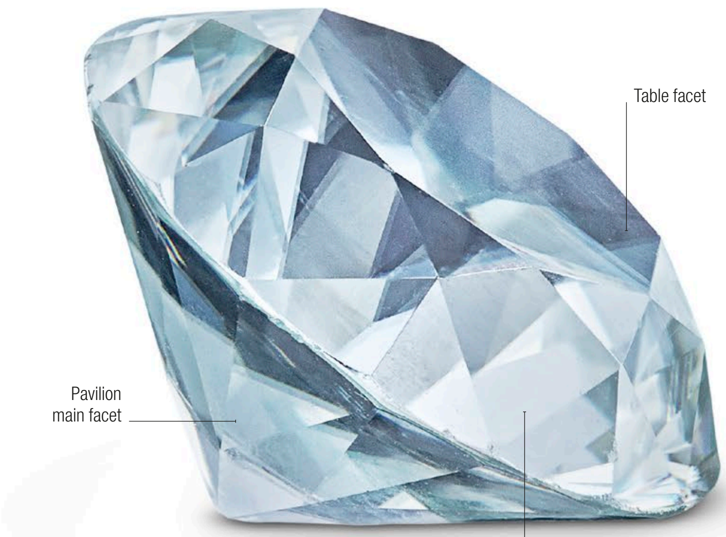
Zircon crystals | Zircon crystals can form in many different types of rock. This specimen is set on a groundmass of pegmatite, a common zircon occurrence.

Classic crystal | This reddish-brown specimen is a typical example of a tetragonal prism capped on both ends by fine pyramid-shaped terminations.

Raw colours | This group of water-rounded, yellow to red-brown zircons demonstrates the variance between specimens when found in their natural state.

Colours and cuts

Blue pendeloque | At 15 carats, this magnificent zircon has been heat-treated to intensify its colour. It is pendeloque-cut and displays superb dispersion.



Side view | Viewed side-on, this 7.28-carat, white specimen exhibits a classic brilliant cut, exposing the many different facets and revealing the mineral's refractive quality.

Champagne colour | The soft colour of this brilliant-cut gem is highly unusual, and is most likely an unexpected response to heat treatment.

Changing colour | Not all heat-treated brown zircons turn a brilliant dark blue – some, like this faceted example, turn a very pleasing, almost transparent, mid-blue.

Blue gems | This group of fine blue, step-cut zircons with deep pavilions displays the blue colour characteristic of heat treatment.

Natural state | Some zircons do not go through heat treatment. This beautiful emerald-cut stone has been kept in its natural reddish-brown state.

Settings

Blue zircon ring | Crafted by jewellery designer Karina Brez, this ring is based around a 10.60-carat blue zircon, set in white gold with white diamonds.

Openwork brooch | A cluster of circular-cut, pale blue zircons sit at the centre of this scrolling gold brooch, with ruby and diamond highlights.

Stunning earrings | Set in white gold, the vibrant blue zircons in these attractive earrings are perfectly complemented by the yellow sapphires at the top of each.

Clear zircon resembles diamond, but the two can be distinguished: zircon exhibits double refraction, while diamond does not

Portrait of Princess Leonilla Bariatinskaia, 1843 | Owner of the Black Orlov diamond in the early 20th century, and part of the inspiration behind the curse

Black Orlov diamond

△ **Nadezhda Petrovna Orlov**, one of the diamond's former owners

The Black Orlov diamond, also known as the Eye of Brahma, is famous for its distinctive colour and notorious for its curse, which is said to bring doom to its owners.

The Black Orlov's colour is not true black but a gunmetal dark grey. The original rough 195-carat stone was later cut to a 67.50-carat cushion cut. It is currently set in a pendant, surrounded by a leaf motif of 800 smaller white diamonds, and hangs from a platinum necklace set with 124 small white diamonds.

The diamond's history is uncertain. It is said to have originally been an eye in a statue of the god Brahma in India, but became cursed after it was stolen by a travelling monk. Supposedly, American diamond buyer JW Paris purchased the stone in 1932, sold it, and jumped to his death from a New York skyscraper shortly afterwards. Later, according to the story of the curse, Russian princess Leonilla Bariatinskaia fell to her death in Rome in 1947 after acquiring the stone – and one month after that, the stone's new owner, Princess Nadia Vyegin-Orlov, also fell to her death from a building in Rome.

The Black Orlov diamond set with hundreds of white diamonds

As with many "cursed" jewels, the truth is debatable. The story of its origin is suspiciously similar to that of the Orlov diamond, a white diamond stolen from an Indian idol and owned by the Orlovs. Mr Paris's plunge went unrecorded, and "Princess Nadia Vyegin-Orlov" is not known as a historical figure. Of the real princesses who owned the stone, Princess Leonilla died in 1918, aged 101, and Nadezhda Petrovna Orlov, who gave the diamond its name, died in 1988, aged about 90. The curse may be baseless, but it has done much for the Black Orlov's mystique.

I'm pretty confident that the curse is broken...

J Dennis **Petimezas**
Owner, 2004–06

The Hindu god Brahma, who is said to have placed a terrible curse on the Eye of Brahma jewel after a travelling monk stole it from a statue of the deity

Key dates

Pre-1800s–2006

- **Unknown** The diamond is supposedly stolen from the eye of Brahma in a shrine in Pondicherry, India, by a monk and is cursed
- **Early 1900s** The Black Orlov's necklace reaches Russia and passes through the hands of "Princess Nadia Vyegin-Orlov" and Princess Leonilla Bariatinskaia
- **1918** Princess Leonilla Bariatinskaia actually dies in France aged 101
- **1932** JW Paris buys the diamond, sells it, and, shortly after, jumps from skyscraper in New York
- **1947** "Princess Vyegin-Orlov" and Princess Leonilla Bariatinskaia allegedly leap to their deaths in Rome, just one month apart
- **c.1950s** Charles F Winson, a New York City gem dealer, buys the stone from persons unrecorded. It is later set in a pendant
- **1988** The real Princess Nadezhda Petrovna Orlov, on whom Princess Nadia may be based, dies aged around 90 in Switzerland
- **1995** The diamond is auctioned to an anonymous collector for $1.5 million
- **2004** J Dennis Petimezas, a jeweller and diamond dealer, acquires the diamond from anonymous private collector
- **2006** The Natural History Museum's "Diamonds Exhibition" in London featuring the diamond is closed early due to threat of robbery

1800 1900 1910 1920 1950 1980 1990 2000

Hindu pagoda in Pondicherry, c.1867

Topaz

△ **Well-formed** topaz crystal

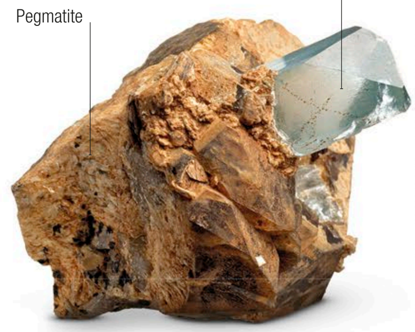
Once, it was believed that all yellow gems were topaz, and that all topaz was yellow – however, neither statement is true. Some topaz is yellow, but it can also be colourless, blue, green, sherry, and its most valuable colour variation, pink. It is fairly refractive, splitting light into its constituent colours; as a result, colourless topaz resembles diamond, and has often been mistaken for it. Additionally, some blue topaz is almost indistinguishable from aquamarine. A certain number of gems on the market have been treated by heat and irradiation to change their colour.

Specification

Chemical name Aluminium fluorosilicate | **Formula** $Al_2SiO_4(F,OH)_2$ **Colours** Yellow, golden, orange, pink, green, blue, colourless **Structure** Orthorhombic | **Hardness** 8 | **SG** 3.5–3.6 | **RI** 1.62–1.63 | **Lustre** Vitreous | **Streak** White | **Locations** Brazil, Russia, Germany, Nigeria, Afghanistan, USA, Pakistan, Japan

Rough

Rough crystals | This group of gem-quality topaz crystals shows a clear colour gradation from yellow and sherry to a dark, almost red hue. The outer texture of these crystals obscures their transparent interiors.



Topaz in pegmatite matrix | This finely crystallized, light blue topaz is resting on a groundmass of pegmatite, a mineral host in which it frequently occurs.

Brazilian topaz | The rich, red-brown colour and excellent transparency of this superb topaz crystal from Brazil make it a gem-cutter's dream.

Topaz as a megagem

Gemstone heavyweights

Topaz is found in well formed, prismatic crystals with a lozenge-shaped cross-section. Although most gemstone material is found in alluvial deposits as water-worn pebbles, a number of very large crystals have also been found in situ. The world's largest preserved topaz crystal weighs 271kg (596lb), and in the 1980s a faceted gem weighing 22,892.5 carats – 4.6kg (10.1lb) – was cut from a Brazilian rock fragment.

Sherry topaz crystal This prismatic crystal shows good form and colour. It comes from the Ouro Preto deposit in Minas Gerais, Brazil, the largest commercial source of sherry topaz.

Brown topaz | A fine, gem-quality topaz, this rough has an unusual brown cast to its colour. Its lightness and transparent surface reveal internal blemishes.

Cut

Fancy cut | The brilliant-cut heart shape – one of the most difficult cuts – of this 12.77-carat blue topaz shows the highest degree of craftsmanship.

Imperial topaz | This oval mixed-cut imperial topaz uses a combination of triangular facets on the crown and rectangular facets on the pavilion to spectacular effect.

Emerald cut | The emerald cut of this large, 55.68-carat gem showcases its deep colour, most likely obtained by heat treatment and irradiation of natural topaz.

Brilliant cut | The masterful cutting of this 81.30-carat brilliant-cut cushion is revealed in a side-on view, in which the layering of facets on the sides of the stone can be seen.

Settings

Antique necklace set | This set, dating from around 1830, features a necklace with accompanying pendant, bracelet, and earrings. The stones comprise matching oval-cut topaz and citrines, and the pendant can also be detached and worn as a brooch.

Blue oval ring | The blue topaz gemstone in this white gold ring setting is cut as an oval brilliant, and set in a particularly deep "basket" mounting.

In ancient times, the name "topaz" was mistakenly applied to peridot crystals

Andalusite

△ **Blocky** andalusite crystals grouped in a matrix

Crystals of andalusite are pleochroic, meaning they appear to be different colours when viewed from different angles. Andalusite is named after Andalusia, the Spanish region where it was first discovered. It is an aluminium silicate, closely related to both silimanite and kyanite, with which it shares the same chemical composition, but it has a different crystal structure. A strikingly beautiful but relatively lesser-known gem type, andalusite is most often opaque or translucent, with transparent specimens being extremely rare.

Specification

Chemical name Aluminium silicate | **Formula** $Al_2(SiO_4)O$
Colours Pink, brown, white, grey, violet, yellow, green, blue
Structure Orthorhombic | **Hardness** 7.5 | **SG** 3–3.2
RI 1.63–1.64 | **Lustre** Vitreous | **Streak** White
Locations Belgium, Australia, Russia, Germany, USA

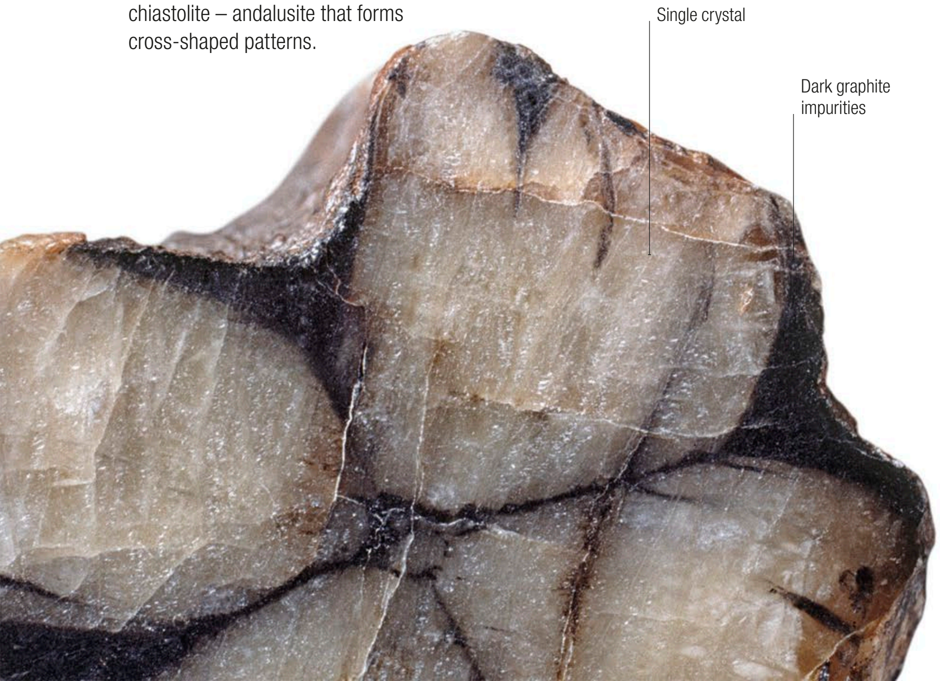
Cross-section | **Rough** | These andalusite crystals are of the variety chiastolite, with a cross-shaped cluster of elongated and tapered crystals.

Smooth cabochons | **Cut** | Chiastolite is often tumble-polished into rounded gems. These fine examples highlight the typical cross-shaped twinning.

Octagonal step cut | **Cut** | This fine octagonal, step cut gem presents a pleasing blend of yellow-tinted brown, highlighted by its bold cut.

Faceted oval | **Cut** | This yellow-tinted andalusite gemstone has an oval step cut, emphasizing the exceptional clarity and briliance of the stone.

Andalusite slab | **Rough** | This specimen is another example of chiastolite – andalusite that forms cross-shaped patterns.



Andalusite is known as the "seeing stone"

Ring with andalusite | **Set** | This disctinctively asymmetrical ring features an oval-cut andalusite gemstone surrounded by a swirl of diamonds.

Titanite

△ **Classic** wedge-shaped titanite crystals on a rock matrix

Formerly known as sphene, (the Greek for "wedge"), titanite is a common mineral in many igneous rocks and in metamorphic rocks such as gneiss and schist. It occurs as translucent or transparent crystals. It is found in numerous locations, and can occur as reddish brown, grey, red, yellow or green monoclinic crystals. Its "fiery" colour results from its high level of dispersion and high refraction index. In addition to its use as gems, it is also a source of titanium dioxide, which is used in pigments.

Specification

Chemical name Calcium titanium silicate | **Formula** $CaTiSiO_5$ | **Colours** Yellow, green, brown, black, pink, blue | **Structure** Monoclinic | **Hardness** 5–5.5 | **SG** 3.5–3.6 | **RI** 1.84–2.11 | **Lustre** Vitrous to greasy | **Streak** White | **Locations** Europe, Madagascar, Canada, USA, Brazil, Russia, Pakistan

Crystal on rock groundmass | **Rough** | Lozenge-shaped titanite crystals cover the top of the rock matrix in this superb collector's specimen.

Faceted oval | **Cut** | This oval brilliant-cut titanite stone has been expertly faceted. Its naturally dark yellow colouring gives its cut a dense appearance.

Rectangular titanite | **Colour variety** | This rectangular, step-cut gemstone has a lower iron content, resulting in the clear, yellow-green colour seen here.

Butterfly with titanite | **Set** | Madagascar is the source of the 11 fine-quality, brilliant titanite gems that provide the sparkle for this 18-karat gold butterfly brooch with sapphire eyes.

Sillimanite

△ **Superbly transparent**, mixed-cut cushion sillimanite

Although mainly an industrial material, transparent sillimanite is the basis of attractive faceted gemstones. Cabochons are cut from a form of sillimanite called fibrolite, so named because the mineral resembles bunches of fibres twisted together. Crystals are long, slender, and glassy, or in blocky prisms. Blue and violet are the most prized colours for gemstones. Sillimanite is distinctly pleochroic: yellowish-green, dark green, and blue can be seen within the same stone from different angles. It is a common mineral in some metamorphic rocks.

Specification

Chemical name Aluminium silicate | **Formula** Al_2OSiO_5 **Colours** Colourless, blue, yellow, green, violet | **Structure** Orthorhombic | **Hardness** 7 | **SG** 3.2–3.3 | **RI** 1.66–1.68 **Lustre** Vitreous or silky | **Streak** White | **Locations** Myanmar, India, Czech Republic, Sri Lanka, Italy, Germany, Brazil, USA

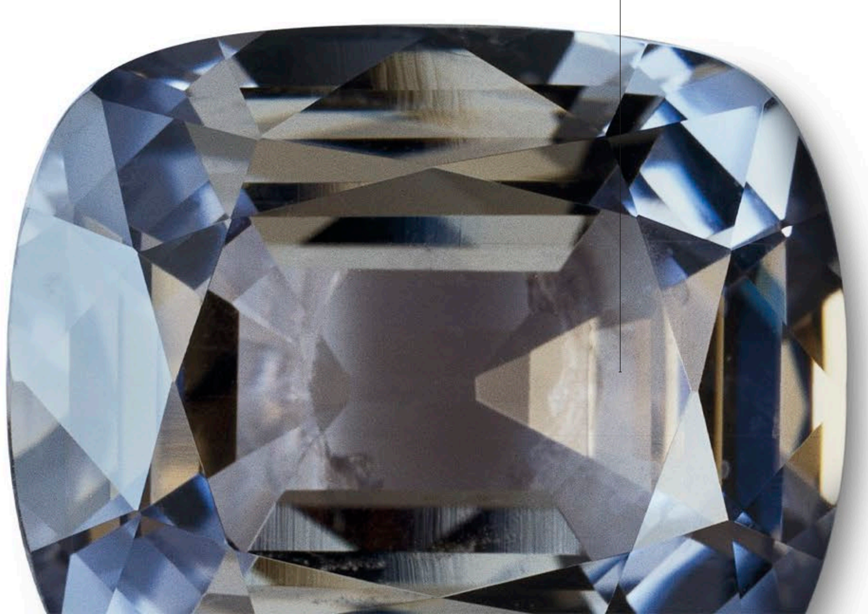
Fibrous rock | **Rough** | This specimen of fibrous sillimanite is typical of its natural occurrence – it is rare to find gem-quality examples of the mineral.

Sillimanite crystals in rock | **Rough** | These elongated, prismatic sillimanite crystals are contained within a matrix of muscovite mica.

Faceted sillimanite | **Colour variety** | This Burmese gem, with a brilliant-cut crown, is a perfect example of the gem's pleochroism, showing bluish-violet and pale yellow colours.

Large oval | **Cut** | Found in Brazil, this stone is exceptionally large, weighing just over 21 carats, and has been faceted to enhance its yellowish-green colouring.

Mixed-cut cushion | **Cut** | The skilful faceting of this fibrolite sillimanite gemstone brings out its particularly fine clarity, transparency, and hue.



Cabochon, emerald, and scissors are the cuts most commonly used for sillimanite

Cat's-eye cabochon | **Cut** | Sillimanite's own fibrous nature sometimes yields a cat's-eye effect when cut *en cabochon*, as illustrated in this stone.

Dumortierite

△ **Richly coloured**, tumble-polished dumortierite

The most prized colours of dumortierite are an intense deep blue to violet. Although sometimes found in small crystals, it is best known in its massive form, when it is used for gemstones cut *en cabochon*, and in carvings. Crystals show pleochroism from red to blue to violet, and have, on rare occasions, been faceted for collectors. Dumortierite occurs in pegmatites, in aluminium-rich metamorphic rocks, and in rocks metamorphosed by boron-bearing vapour from intruding bodies of granite.

Specification

Chemical name Aluminium-iron borosilicate | **Formula** $Al_7(BO_3)(SiO_4)_3O_3$ | **Colours** Blue, violet, brown, green **Structure** Orthorhombic | **Hardness** 7–8.5 | **SG** 3.2–3.4 **RI** 1.68–1.69 | **Lustre** Vitreous | **Streak** White | **Locations** USA, Madagascar, Japan, Canada, Sri Lanka, South Africa, Italy

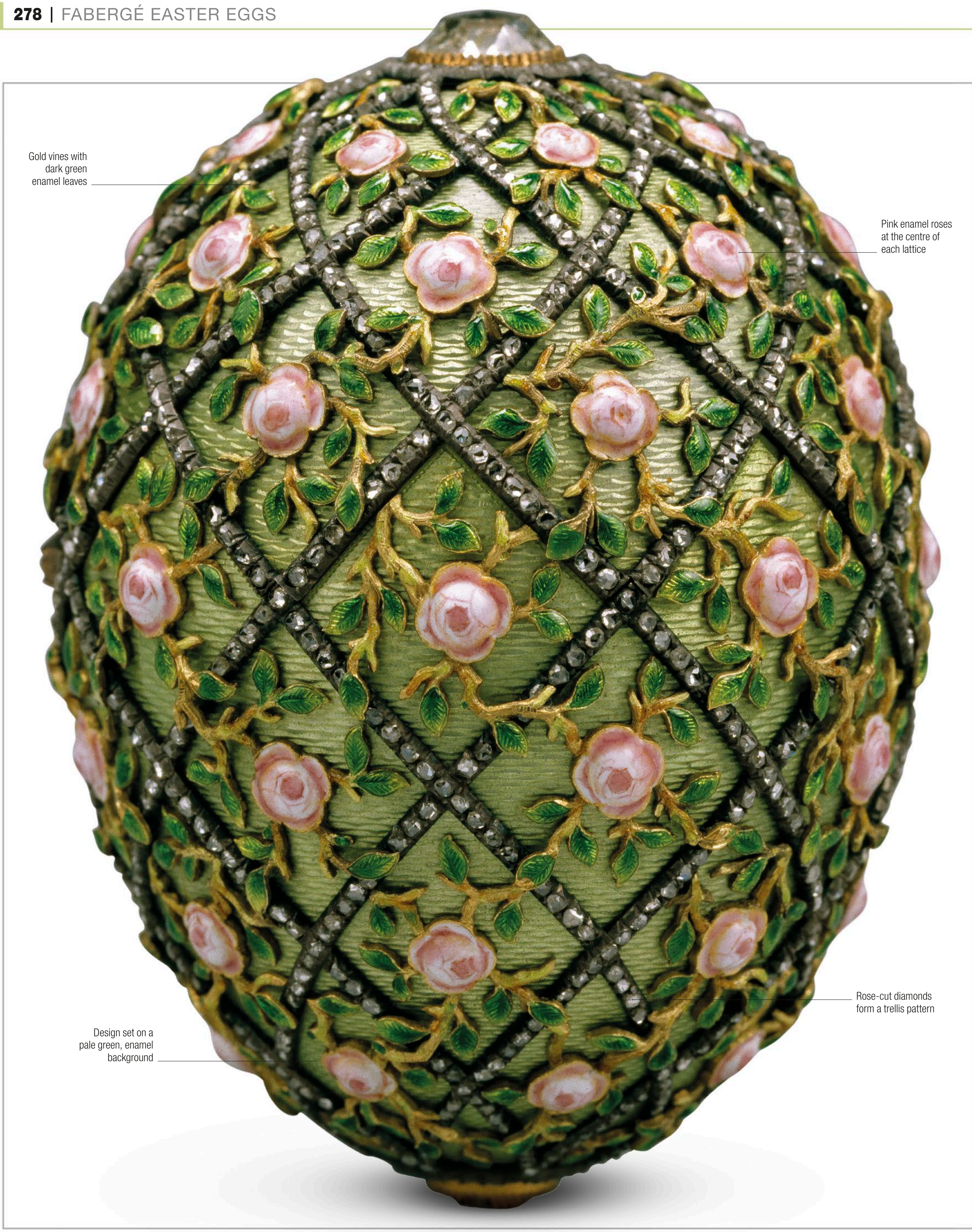
Dumortierite in matrix | **Rough** | The intense blue acicular dumortierite crystals contrast with the whitish-brown rock in this matrix specimen.

Dumortierite rock | **Rough** | This dumortierite rough shows a vivid blue colouring. This specimen could be cut into highly desirable cabochons.

Tumbled gem | **Colour variety** | Even when tumble-polished, this dumortierite stone is valuable for its strong colour, heightened by the smooth and shiny finish.

Oval cabochon | **Cut** | The streaks of the white mineral within this high-domed dumortierite cabochon lend texture and interest to the stone.

Rare obelisks | **Carved** | Cut from massive Brazilian dumortierite, this stunning pair of 71cm (28in) high obelisks are designed as a household ornament. The cut makes the most of the banded colour variation of the original specimen.



Rose Trellis Egg | 1907 | 77 x 59cm (3 x 2¼ in) | Gold, enamel, diamonds

Fabergé Easter eggs

△ **Coronation Egg**, which contained a replica of Tsarina Alexandra's coronation coach

In the Russian Orthodox Church, Easter has always been the most important date in the calendar. After fasting for weeks during Lent, the faithful could look forward to the climax of the celebrations on Easter Sunday, when eggs – one of the prohibited foods – would be exchanged. These ranged from real, hand-painted eggs to artificial ones, produced as presents for ladies. The most sumptuous of all were the jewelled eggs created by Carl Fabergé for the tsarinas (empresses) of Russia.

Lily of the Valley Egg, a gift from Nicholas to Alexandra featuring Art Nouveau styling

Fabergé designed his first imperial egg in 1885, when Alexander III commissioned one as a gift for his wife. From the outset, Carl was determined to do more than simply create an aesthetic arrangement of valuable gems. Instead, he hoped to delight his royal client by placing a surprise within a surprise. Inside his plain, enamelled Hen Egg, there was a golden yolk, containing a tiny golden hen. This in turn could be opened up to reveal two further surprises: a miniature, diamond crown and a ruby pendant.

The Hen Egg proved a huge success and Fabergé was engaged to create a similar gift each year. This became something of a royal tradition, lasting for over 30 years, until the outbreak of the Revolution. The most exquisite example, perhaps, is the Coronation Egg, which was ordered as a gift for the newly crowned empress, Alexandra. The "surprise" was a perfect, miniature replica of the coach that was used in the ceremony, while the colour scheme of the egg-shell echoed the design of her dress. A decade later, in April 1907, the Tsarina received the Rose Trellis Egg to commemorate the birth of her first and only son, Alexei. Decorated with pink enamel roses and a lattice of rose-cut diamonds, the egg contained a diamond necklace and a portrait of the young Tsarevich Alexei.

Carl Fabergé's workshop in St Petersburg, Russia, pictured around 1910, after Carl and his brother Agathon expanded their business to increase capacity

Monsieur Fabergé's work reaches the limits of perfection

Review
Paris Exposition Universelle, 1900

Key dates

1793–2013

1800

- **1793** Catherine the Great commissions the coach that appears in the Coronation Egg
- **1885** Carl Fabergé produces his first Easter egg – the Hen Egg – for a Russian Emperor
- **1896** The coronation of Tsar Nicholas II and Alexandra takes place in Moscow

1900

- **1897** At Easter, Nicholas presents the Coronation Egg to Tsarina Alexandra

Tsarina Alexandra, Empress of Russia

- **1907** Nicholas presents the Rose Trellis Egg to Alexandra to mark the birth of Tsarevich Alexei

1910

- **1918** Nicholas and Alexandra are murdered by Bolsheviks in the aftermath of the Russian Revolution

1925

- **1927** Joseph Stalin sells several of the eggs to enable him to acquire foreign currency. Many are taken to the West

Bolshevik poster from the Russian Revolution

1950

2000

- **2007** The Fabergé family are reunified with the Fabergé brand, having lost their rights to the name in 1920
- **2013** Viktor Vekselberg, owner of the single largest collection of Fabergé eggs in the world, opens Fabergé Museum in St Petersburg

2015

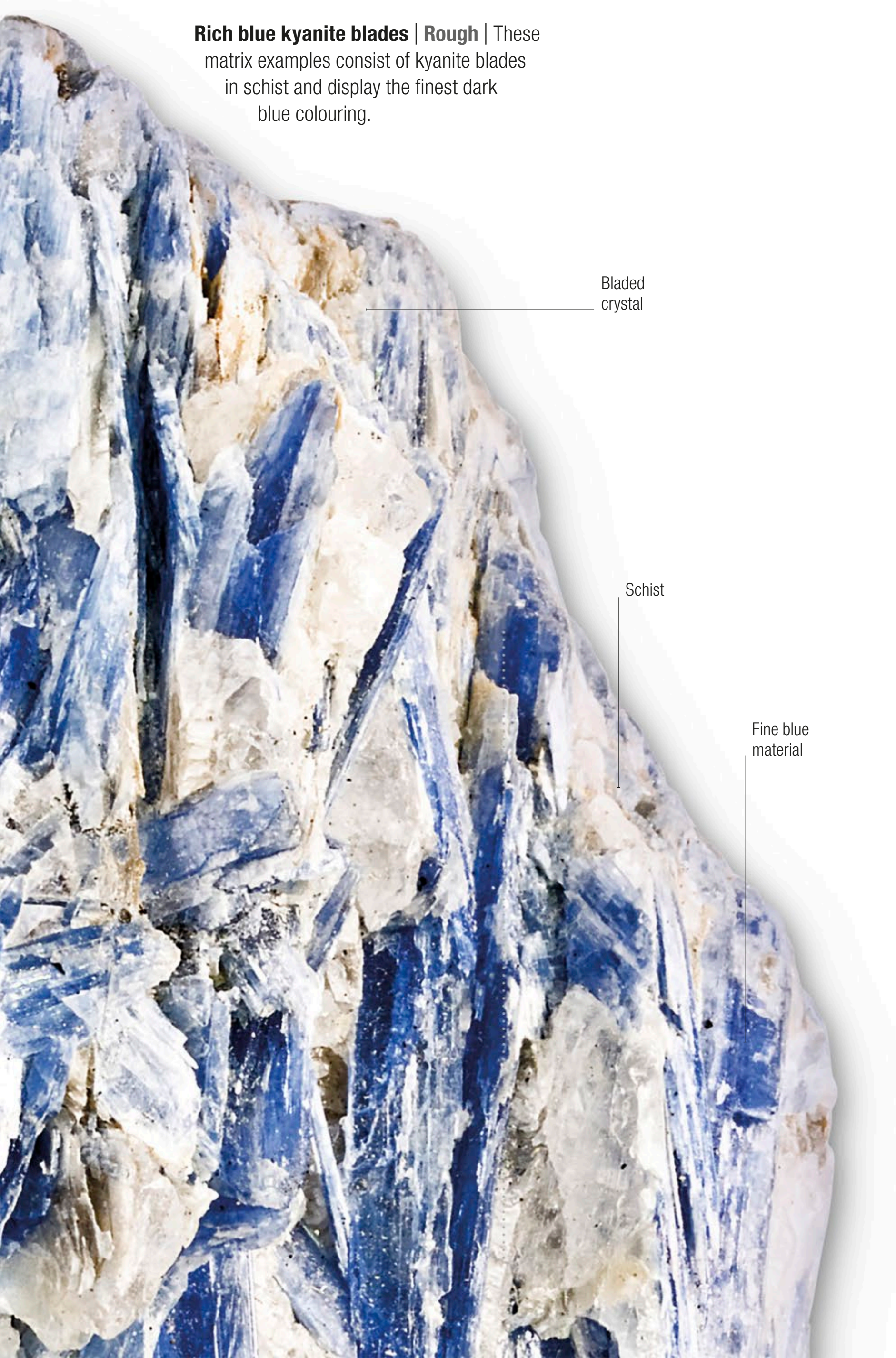
Kyanite

△ **Gem kyanite rough** showing unusual thickness

Usually blue or blue-grey, and generally mixed or zoned within a single crystal, kyanite can also be green, orange, or colourless. Kyanite mainly occurs as elongated blades that are often bent, and less commonly as radiating, columnar aggregates. Kyanite is formed during the metamorphism of clay-rich sediments. It occurs in mica schists, gneisses, and associated hydrothermal quartz veins. Until recently it was not considered a gem mineral, but in the last decades transparent material has been found. Stones cut from it rival blue sapphire in intensity of colour.

Specification

Chemical name Aluminuim silicate | **Formula** Al_2SiO_5 **Colours** Blue, green, orange, colourless | **Structure** Triclinic | **Hardness** 4.5–7 | **SG** 3.5–3.7 | **RI** 1.71–1.73 **Lustre** Vitreous | **Streak** Colourless | **Locations** Brazil, Switzerland, USA



Rich blue kyanite blades | **Rough** | These matrix examples consist of kyanite blades in schist and display the finest dark blue colouring.

Bladed kyanite crystals | **Rough** | Kyanite classically forms relatively thin, bladed crystals, such as these gem-quality specimens in a matrix.

Kyanite sphere | **Carved** | The skill of the lapidary is evident in this carved sphere, as the blue kyanite is set in calcite, which is much softer than the kyanite.

Fine oval | **Colour variety** | While it is not the deepest kyanite blue, the colour of this oval brilliant gem is close to that of fine Burmese sapphire.

Ear clips | **Set** | This pair of flower head ear clips is set with rich blue kyanite oval-cut stones, each of which is surrounded by a fringe of tiny diamonds.

Staurolite

△ **Staurolite in schist** from Russia showing cross-shaped twinning

Staurolite is hydrous iron magnesium aluminium silicate. It occurs with garnet, tourmaline, and kyanite or sillimanite in mica schists and gneisses and other metamorphosed aluminium-rich rocks. Staurolite is reddish-brown or yellowish-brown, or nearly black, and normally occurs as prisms which are hexagonal or diamond-shaped in section. Staurolite is named from the Greek *stauros*, "cross", and *lithos*, "stone", for its cross-like twinned form. These cross-shaped crystals are frequently set in silver for use in religious jewellery.

Specification

Chemical name Aluminuim silicate | **Formula** $(Fe,Mg)_4Al_{17}(Si,Al)_8O_{45}(OH)_3$ | **Colour** Brown | **Structure** Monoclinic | **Hardness** 7–7.5 | **SG** 3.7 | **RI** 1.74–1.75 **Lustre** Vitreous to resinous | **Streak** Colourless to grey **Locations** USA, France, Brazil

Staurolite and kyanite specimen | **Rough** | Staurolite and kyanite often occur together, as in this specimen of matrix of muscovite mica schist.

Staurolite schist | **Rough** | Staurolite commonly occurs in a groundmass of mica schist. In this example, the crystals are rich brown and gemmy.

Twin staurolite crystal | **Rough** | This specimen of cross-shaped crystal of staurolite displays typically geometric lines caused by twinning.

Single crystal | **Rough** | This twin of staurolite has been separated from its matrix. These crystals are frequently mounted as pendants.

Carved sphere | **Carved** | Small crystals are set in a feldspar and mica matrix in this rare sphere. The material originates from the Kola Peninsula of Russia.

Phenakite

△ **Large, finely-formed** gem quality phenakite crystals on matrix

Phenakite's name originates from the Greek for "deceiver" – see box, below. It can be colourless, but more often is translucent grey or yellow and, occasionally, pale rose-red. Phenakite is found in high-temperature pegmatites and in mica-schists, often accompanied by quartz, chrysoberyl, apatite, and topaz. Its crystals are mainly rhombohedrons, and somtimes short prisms. Transparent crystals are faceted for collectors. Its indices of refraction are higher than topaz, and its brilliance approaches that of diamond.

Specification

Chemical name Beryllium silicate | **Formula** Be_2SiO_4 | **Colours** Colourless, white | **Structure** Hexagonal/trigonal | **Hardness** 7.5–8 | **SG** 3 | **RI** 1.65–1.67 | **Lustre** Vitreous | **Streak** Colourless | **Locations** Russia, Norway, France, USA

Large crystal | **Rough** | This large single crystal of phenakite with adhering matrix at the base shows perfect phenakite crystal form.

Brazilian phenakite | **Cut** | Cut in a fancy cushion with multiple, layered facets, this stunning Brazilian stone weighs 29.80 carats.

Burmese phenakite | **Cut** | This extremely fine, totally colourless 25.57-carat brilliant oval-cut phenakite from Myanmar is nearly an inch in length.

Phenakite and quartz

The great deceiver

Phenakite has a well-deserved reputation for deception, also the basis for its name – it is difficult to to distinguish it from colourless quartz, both in its appearance and its technical specifications. Mineralogists can use various solutions to tell the two substances apart, including testing their specific gravity (quartz's is slightly lower, at 2.65, while phenakite's is 3) or their hardness (phenakite is slightly harder). The latter can be tested by conducting a scratch test on a piece of quartz.

Clear quartz crystals This specimen of rough rock crystal could potentially be mistaken for phenakite.

Euclase

△ **Single euclase crystal** from Chivor, Columbia, weighing 46.2 carats

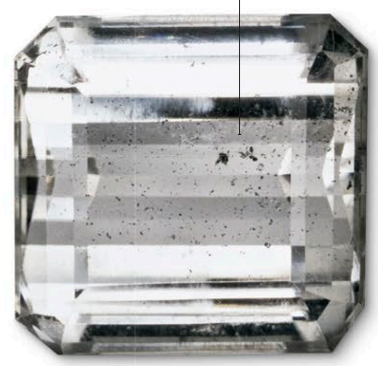
Euclase is beryllium aluminium hydroxide silicate. It is generally white or colourless but can also be pale green or pale to deep blue – a colour for which it is particularly noted. It forms grooved prisms, often with complex end faces, and can also be found in masses and fibres. In faceted gems, pale to rich aquamarine is favourite, but other colours are also cut. It is relatively uncommon in gem material, and is principally cut for collectors. Euclase takes its name from the Greek *eu*, "good", and *klasis*, "fracture", in reference to the way in which it breaks in perfect planes.

Specification

Chemical name Beryllium silicate | **Formula** $BeAlSiO_4(OH)$ | **Colours** Colourless, white, blue, green **Structure** Monoclinic | **Hardness** 7.5 | **SG** 3 **RI** 1.65–1.67 | **Lustre** Vitreous | **Streak** White **Locations** Brazil, USA

Prismatic colourless euclase crystal | **Rough** | This single, perfectly formed euclase crystal displays a fine prismatic form. It is technically colourless, although it appears to have a yellowish tinge to its interior.

Matrix specimen | **Rough** | Aside from being gem-quality, this blue euclase crystal, resting in a groundmass of quartz sprinkled with pyrite, is a fine specimen.



Octagonal gemstone | **Cut** | Full of dark inclusions yet a desirable stone, this colourless euclase is faceted in deep step-cut.

Brazilian stone | **Cut** | Featuring an emerald cut and a medium blue-green colour, this Brazilian stone originates from the Minas Gerais region.

Cushion-cut euclase | **Cut** | This cushion-cut gem also come from Brazil, and weighs 7.17 carats. It displays a greyish blue colouring.

Napoleon diamond necklace | Commissioned in 1811 | About 20cm (7¾in) wide | 234 diamonds weighing about 263 carats, seen here in a portrait of Empress Marie-Louise

Napoleon diamond necklace

△ **Emperor Napoleon I** in a portrait by François Gérard (detail), c.1805–15

Commissioned by Napoleon I of France in 1811 for his wife Empress Marie-Louise to celebrate the birth of their son, this necklace is composed of 234 diamonds. The single thread is set with 28 mine-cut (the earliest form of brilliant-cut) diamonds. A second tier has nine pendeloques and 10 briolettes (teardrop-shaped cuts).

Napoleon had divorced the Empress Josephine, who had failed to give him an heir, and married Archduchess Marie-Louise of Austria in 1810. Napoleon's son was born within a year, and he duly commissioned the Parisian jewellers Etienne Nitot et fils to produce the 376,274-franc necklace, a sum equal to the Empress's entire annual household budget. Marie-Louise wore the necklace in several contemporary portraits and kept it until her death.

Maria Theresa of Portugal, who inherited the necklace in 1914

Maria Theresa, a princess of Portugal, eventually inherited it and, in 1929, decided to sell. She engaged two agents, "Colonel Townsend" and "Princess Baronti", to sell the necklace for $450,000. As the stock market had just crashed, this figure proved unrealistic and the agents began offers at $100,000, enlisting Archduke Leopold of Hapsburg, Maria Theresa's penniless grandnephew, to give assurances of authenticity to buyers. The necklace eventually sold for $60,000, but the agents and Archduke Leopold claimed a collective fee of $53,730 as expenses. Maria Theresa took the matter to court, recovered the necklace, and Leopold was jailed. The "Townsends" evaded capture, however, and their true identities remain a mystery.

Key dates

1811–1962

- **June 12, 1811** Napoleon commissions the necklace to celebrate his son's birth
- **20 March, 1811** Napoleon's son, Napoleon François-Joseph Charles, is born to Marie-Louise
- 1800
- **1847** Marie-Louise dies. The necklace passes to Archduchess Sophie of Austria. Two diamonds are removed for earrings
- 1850
- **1872** On Sophie's death, the necklace is inherited by her sons, archdukes Karl Ludwig, Ludwig Viktor, and Franz Joseph of Austria
- 1900
- **1914** The necklace passes to Karl Ludwig's third wife, Maria Theresa of Portugal, on his death
- 1920
- **1929** Maria Theresa tries to sell the necklace, but recovers it after an attempt to swindle her out of the proceeds
- 1940
- **1944** Maria Theresa dies
- **1948** The Hapsburg family sells the necklace to French industrialist Paul-Louis Weiller
- 1960
- **1960** Harry Winston buys the necklace from Weiller and later sells it to Marjorie Merriweather Post
- **1962** Post donates the necklace to the Smithsonian Institution. It remains on display at the National Museum of Natural History, Washington DC
- 1980

Paul-Louis Weiller and his wife at the Academy of Fine Arts, Paris, 1965

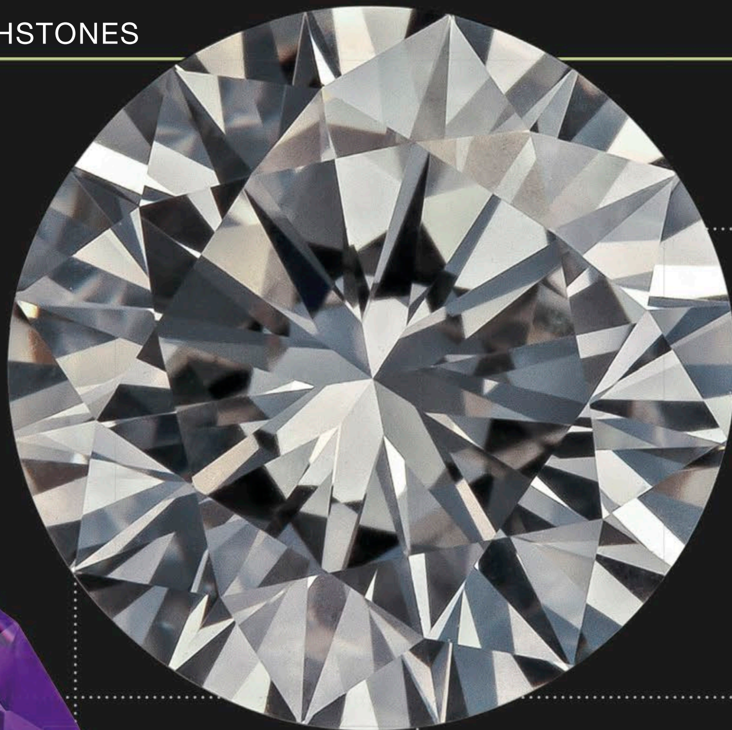
> **Thirteen… diamonds are type IIa [almost completely pure]… consistent with the jewel's imperial pedigree**

Drs **E Gaillou** and **J Post**
National Museum of Natural History, Smithsonian Institution

January – Garnet
Garnet was associated with January in the ancient Ayurvedic tradition, as well as in modern Western lists.

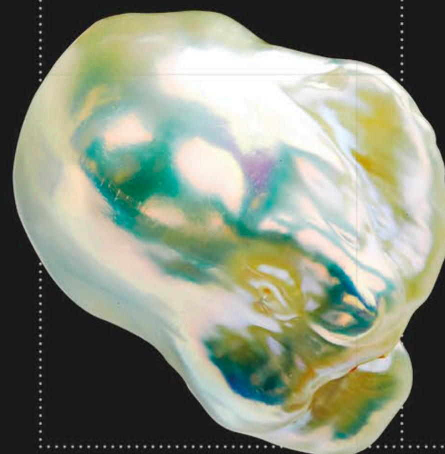
February – Amethyst
Associated with royalty and wine, amethyst is the birthstone for February in modern and ancient lists.

March – Aquamarine
In 1952, aquamarine was designated as March's birthstone. It is said to bring calm.

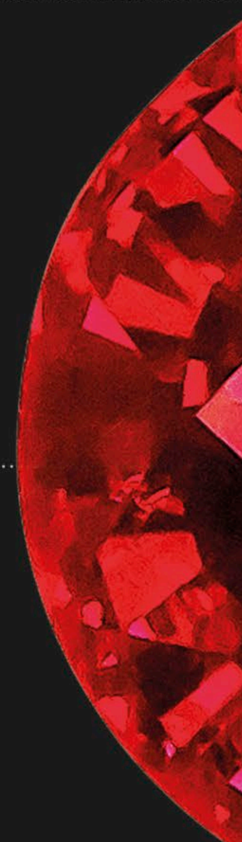


April – Diamond
Assigned to April in the modern tradition, diamond is also said to improve relationships for those with April birthdays.

May – Emerald
Western birthstone tradition has roots in the Bible, which links gemstones, including emerald, to zodiac signs.



June – Pearl
Pearl, representing purity, is the most traditional gem for June, but moonstone and alexandrite are also popular.



Lucky **birthstones**

Each of the 12 signs of the zodiac has long been associated with a gem, which is thought to strike a chord with the character of someone born under that sign, and so bring the person good luck. Later, the gemstones were linked to months rather than astrological signs. The major stones occur in most cultures, though how they are assigned can vary. In this modern set of European associations, March can also be linked to bloodstone; moonstone is an alternative to pearl for June; sardonyx is lucky for August and topaz for November, while turquoise can be a December birthstone.

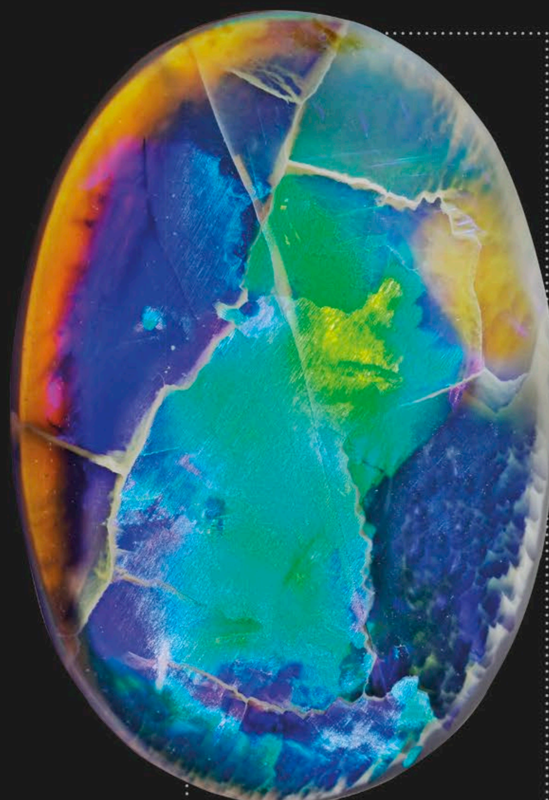
Rubies ensure health, wealth, and a cheerful nature to the owner

Old Hindu belief

July – Ruby
Ruby is both the modern and traditional birthstone for July; it is associated with passion.

August – Peridot
Prior to 1900, August's birthstone was variously sardonyx, carnelian, moonstone, or topaz.

September – Sapphire
Sapphire is thought to protect loved ones from envy and from harm. It is also the zodiac stone for Taurus.



October – Opal
Opal was designated as October's birthstone by the American National Association of Jewelers in 1912.

November – Citrine
This is one of the more recent additions to the list, put forward by American jewellers in 1952.

December – Zircon
Zircon was recognized as one of the birthstones for December in 1952, when it replaced lapis lazuli.

Mask of Agamemnon | c.1500 BCE | Gold mask, repoussé method | Discovered in a burial shaft designated Grave V, at the site Grave Circle A, Mycenae

Mask of Agamemnon

△ **Agamemnon** depicted in a painting c.1633

A gold death mask, the Mask of Agamemnon is one of the world's most famous – and controversial – archaeological artefacts. It was found covering the face of a body in shaft graves in Mycenae, Greece, in 1876.

Made from a thick sheet of gold that has been hammered over a wooden mould, it depicts the face of a bearded man. Fine textures, such as the eyebrows and beard, were added using a sharp tool. Heinrich Schliemann, the archaeologist who found it, claimed he had "gazed on the face of Agamemnon", legendary king and leader of the famous attack on ancient Troy. This claim was later refuted when it emerged that the graves, from around 1500 BCE, predated the Trojan War by around three centuries, although the site was still identified as Troy. The name has stuck, however, and the mask is accepted as a genuine artefact by the National Archaeological Museum of Athens, where it remains a highlight today.

Typical ancient Greek death mask

However, critics point to the atypical features – facial hair, separate ear flaps, and distinct eyebrows – none of which are present on other masks of the same period at the site. Schliemann had been suspected of "salting" his previous finds with treasures from other sites, and detractors suggested he may have planted a forgery, or reworked an ancient mask. Calls have been made to test the age of the mask – ancient gold is impure and contains alloyed minerals that corrode over time, which can help establish age. However, the Archaeological Museum of Athens regards doubts about the mask as unfounded, and it remains one of the world's most intriguing pieces of precious metalwork, as well as a stunning artefact in its own right.

I have gazed on the face of Agamemnon

Heinrich **Schliemann**
in a telegram to a Greek newspaper on finding the mask

Scene from the Trojan War in a 16th-century Italian fresco, featuring the Trojan horse, with which Agamemnon tricked the Trojans and took the city of Troy

Key dates

c.1500 BCE–1983

1500

c.1550–1500 BCE The mask is created and buried in a grave shaft

1200

c.1260–1180 BCE The modern date range of the Trojan War, and time of mythic figure Agamemnon, are too late to coincide with the mask

0

Archaeologist Heinrich Schliemann

1800

1871 Heinrich Schliemann begins work at Troy (modern-day Hisarlik) at the behest of British archaeologist Frank Calvert

1850

1876 Schliemann discovers the mask and cables the King of Greece

1900

1972 Archaeologist David Calder criticizes Schliemann's work and other critics follow, casting doubt on his finds

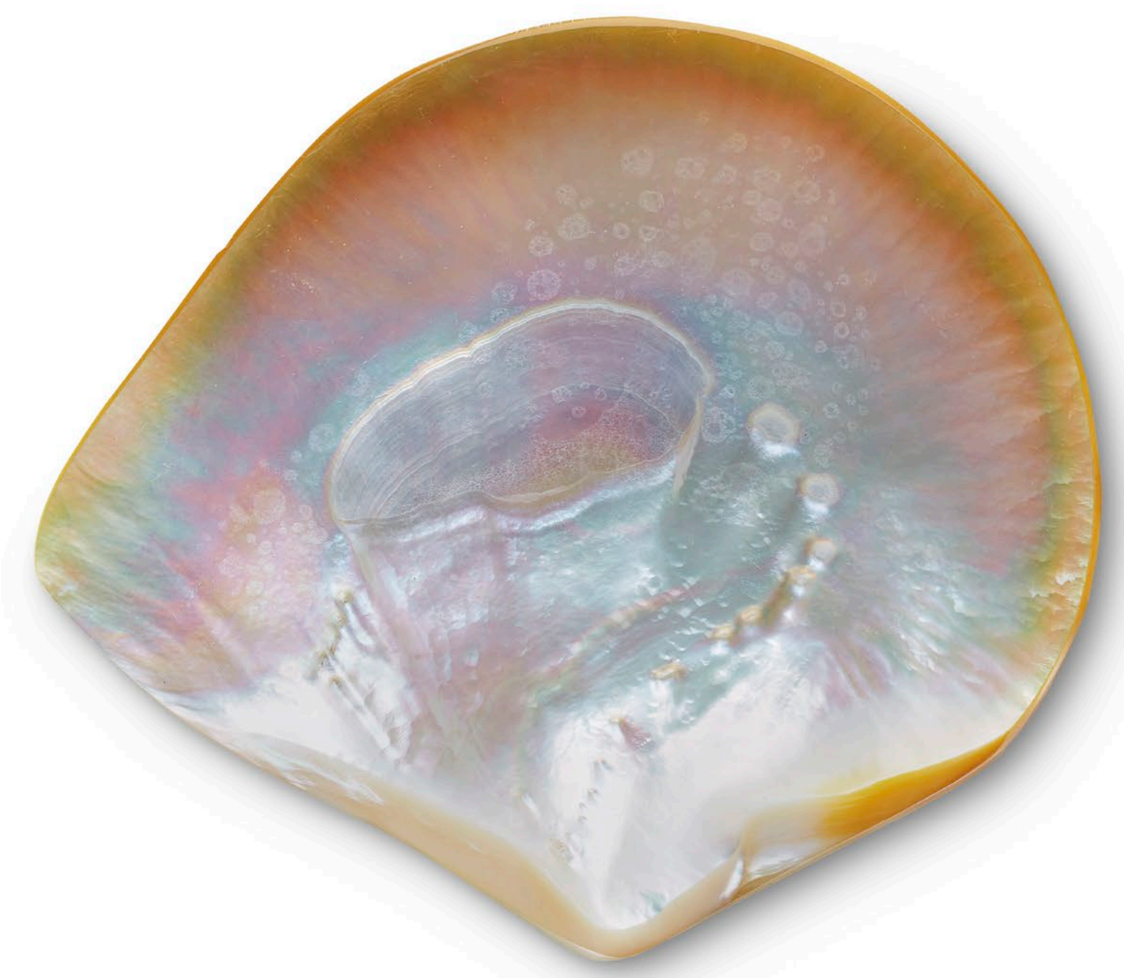
1950

1983 The Central Archaeological Council rejects a request for the mask to be tested on advice from the National Archaeological Museum, Athens, where the artefact still resides

2000

3

Organic gems



The Canning Jewel | This Italian Renaissance pendant is in the form of a merman holding a gorgon's head. His "body" is a large blister pearl set in enameled gold, with rubies, table-cut diamonds, and baroque pearls.

In Japan, pearl hunters have been diving without breathing equipment for around 2,000 years

Pearl

△ **Spherical pearl** showing iridescence

Pearls are natural gems produced by the pearl oyster and the freshwater pearl mussel. Although other kinds of mollusc can produce a “pearl”, these have little value as they are not composed of nacre (the same substance as mother-of-pearl). Nacre is secreted in response to a microscopic irritant in the mollusc’s soft tissue. The concentric rings of nacre around the particle create the particular iridescence of pearls due to the way the overlapping layers diffract light waves. A pearl’s colour is described in terms of body colour and overtone – the most common body colour is white, though it can range widely, and the overtone is the colour that seems to appear only on the surface of the pearl.

Natural and man-made

Natural pearls that form in the wild are rare, and therefore valuable, and pearl divers have to open hundreds of pearl oysters before chancing on a specimen. Although diving for natural pearls still occurs in Bahrain and off the coast of Australia, today’s pearls are largely cultured, making them much more affordable: an artificial nucleus, such as a round shell bead, is placed in the oyster or mussel for the nacre to form around. Freshwater pearls are cheaper because the freshwater mussel can produce up to 20 pearls at a time, whereas the smaller saltwater oyster can create just one. Saltwater pearls are differentiated by region: South Sea pearls are most valued due to their size, Tahitian pearls are next for their colours (black among them), with Akoya the least prized, being the most common.

Specification

Chemical name Calcium carbonate | **Formula** $CaCO_3$
Colours white, pink, silver, cream, brown, green, blue, black, yellow | **Structure** Amorphous | **Hardness** 2.5–4.5
SG 2.60–2.85 | **RI** 1.52–1.69 | **Lustre** Pearly

Locations
1 Coastal waters of Japan **2** Coastal waters of China
3 Coastal waters of Australia

Key pieces

Roman earring | Crafted in a style common in the 3rd century CE, this extravangant Roman earring is set with garnets cut *en cabochon* and five natural pearls suspended on gold mounts.

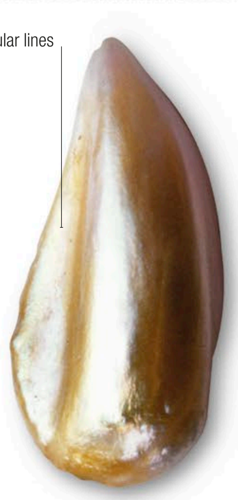
The Hope Pearl | One of the former owners of the Hope Diamond (see pp.62–63), 19th-century collector Henry Hope also acquired this stunning 450-carat bronze-to-white baroque pearl capped with gold and enamel.

The Baroda Necklace | Originally a seven-strand necklace belonging to Maharajah Khande Rao Gaekwad of Baroda, India, this piece was reduced in size in the mid-20th century. It is still the world’s most valuable pearl necklace.

Rough

Mother-of-pearl | The lining of pearl-producing molluscs, mother-of-pearl, is the same material as pearl – a mixture of aragonite in conchiolin called nacre. It can be seen lining the interior of this shell with an iridescent sheen.

Queen conch pearl | Of the molluscs that produce pearls, the queen conch is among the rarest. Its pearls have a distinctive look, as seen in this deep pink pearl.



Baroque pearl | While perfectly round pearls are considered the most desirable by some, baroque pearls such as this black pearl offer more creativity for the jeweller.

Freshwater baroque white pearl | This baroque, white pearl is the kind that could provide the centrepiece for a whimsical sculptured gold jewellery piece.

Freshwater pearls | Freshwater pearls such as these have exactly the same makeup and lustre as saltwater pearls, and were more accessible to ancient man.

The Palawan Princess

The world's second largest pearl

Found in the coastal waters off the Island of Palawan in the Philippines, the Palawan Princess is the world's second largest known pearl, weighing 2.27kg (5lb) – equivalent to 11,340 carats. The product of the giant clam shell species *Tridacna giga*, the pearl is not considered a gem pearl because it is non-nacreous and lacks the lustre of gem pearls. Nevertheless, it was valued at around $300,000–$400,00 in 2009.

Palawan princess It has been said that the pearl's shape bears an uncanny resemblance to a human brain.

Cultivated pearls | This group of four pearls are all cultivated, and display the colour variations possible depending on the growth environment.

Settings

Gold and pearl pin | Created in the form of a eight-pointed star, this gold pin is set with a large central pearl, pearls on each point, and pearls on "rays".

Baroque necklace | This Van Cleef & Arpels necklace uses baroque pearls – 11 drop-shaped pearls suspended from a necklace of diamond-set gold beads.

Multi-coloured pearl earrings | These pendant earrings set in 18-karat white gold feature pearl drops of three different colours suspended from diamond-set mountings.

Ancient Egyptian queen Cleopatra was said to dissolve pearls in vinegar and drink the mixture

Alessio Bosche bracelet-ring | Set with a number of Tahitian pearls, two cushion-cut tanzanites, and white and yellow diamonds, this unusual piece of jewellery is designed to be worn extending from the wrist to the finger.

Cartier trinity ring | Featuring an eye-catching cluster of white, gold, and pink freshwater pearls, this trinity ring made by Cartier is based around interlocking bands of white and yellow gold set with pavé diamonds.

Pearl brooch | Set in white gold, this brooch takes the form of diamond-set leaves supporting a group of three drop-shaped pearl dangles.

Fortune ring | Set with a white South Sea cultured pearl, this 18-karat white gold ring by Mikimoto also features diamond-studded "leaves".

Black pearl necklace | Produced by YOKO, London, this black pearl necklace transitions from dark Tahitian pearls, through grey, to silvery Australian South Sea pearls.

Cartier pearl necklace or bracelet set | In this Cartier piece, accented with tanzanite and diamonds, the second strand of pearls is detachable for use as a bracelet.

La Peregrina | 25.5 x 17.9mm (1 x ¾in) | 50.56 carats (55.95 carats in original form) | Hangs from a necklace worn by Queen Mary I in a portrait from 1544

La Peregrina

△ **La Peregrina**, a drop-shaped, 50-carat natural pearl

Although not the largest natural pearl in the world (that honour goes to the Pearl of Allah), La Peregrina's almost perfect pear shape and its bright white lustre have made it one of the most celebrated gems of the past 500 years. The other reason for the pearl's reputation is its provenance – it was worn by Queen Mary I of England in the 16th century, stolen by Napoleon's brother Joseph in the early 19th century, and owned by actress Elizabeth Taylor.

According to 16th-century Peruvian writer Inca Garcilaso de la Vega, the son of a Spanish aristocrat and Incan noblewoman, the pearl was found in the early 1550s by an African slave working in a Panama fishery – he was given his freedom in return. The largest known pearl at the time, it was brought to Spain as a gift for King Philip II and become part of the Spanish crown jewels. "Its circumference, at the largest part, was the same as a large pigeon's egg", wrote de la Vega. It was named La Peregrina ("The Incomparable") because it was so rare. King Philip gave the pearl, hanging from a necklace, to Mary Tudor (later Queen Mary I) as an engagement present. After Mary's death, La Peregrina was returned to Spain, where it was worn by generations of royalty before Joseph Bonaparte snatched it in 1813. It later resurfaced in England where, in 1969, actor Richard Burton bought it for his wife, Elizabeth Taylor. On one occasion, her dog is said to have picked up the pearl in its mouth – fortunately, La Peregrina escaped unharmed.

La Peregrina in Elizabeth Taylor's chosen design

Elizabeth Taylor wearing La Peregrina in her role on the set of the film *Anne of the Thousand Days*

> I was **dreaming** and **glowing** and **wanting** to **scream with joy**

Elizabeth **Taylor**
on receiving La Peregrina

Key dates

1513–2011

1500

1513 A slave discovers the pearl in a Panama fishery and presents it to Philip II of Spain

1550

1554 Mary Tudor of England's future husband, Philip II, gives her the pearl

1558 After Mary's death, the pearl is returned to Spain

1600

1598–1621 It is owned by Philip III and his wife Margaret of Austria, whose portraits by Diego Velázquez show them wearing the pearl

1700

Queen Margaret of Austria

1800

1813 Joseph Bonaparte, appointed ruler of Spain in 1808 by his brother Napoleon, takes La Peregrina when he flees the country

1844 On Joseph's death, the pearl is bequeathed to his son Louis

1850

1848 Louis sells the pearl to the Duke and Duchess of Abercorn

1900

1969 Richard Burton buys the pearl at auction as a gift for Elizabeth Taylor

1972 The pearl is set as a pendant hanging from a diamond and ruby necklace designed by Taylor and Al Durrante of Cartier

2000

2011 La Peregrina is sold at auction to an anonymous buyer

Shell

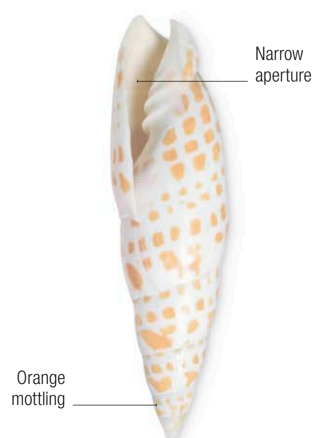
△ **Common** spider conch shell

Seashells are the exoskeletons of molluscs, composed primarily of a mineral secretion, as opposed to living cells. Seashells have a long history of use in body ornamentation, and the cowrie, in particular, in currency. Tortoiseshell is of a different substance – the scutes (plates) of the shell used decoratively are of keratin, the protein that also forms fingernails and hair. Tortoiseshell is actually from the Hawksbill turtle, which is now protected. It is a natural plastic, meaning it can be heated and moulded into new shapes.

Specification (seashell)

Chemical name Calcium carbonate, aragonite
Formula $CaCO_3$ | **Colours** White, pink, silver, cream, brown, green, blue, black, yellow | **Structure** Amorphous
Hardness 3–4 | **SG** 2.60–2.78 | **RI** 1.52–1.66 | **Lustre** Pearly | **Locations** Worldwide

Pink conch | **Rough** | Adult conch shells can grow up to around 30cm (12in) in size. Parts of shells were used by tribes in North America and the Caribbean to make tools.



Episcopal mitre shell | **Rough** | This is the shell of a large sea snail of the species *Mitra mitra*. It is traditionally said to resemble a bishop's headdress.

Shell pitcher | **Set** | This magnificent pitcher from the Argenti Museum in Florence, Italy, is made from nautilus shells. It is also set with pearls, rubies, and turquoise, and is mounted with gilt silver.

Tortoiseshell comb | **Set** | Although it is now prohibited, tortoiseshell was once used as an organic gem. This comb features an ornate tortoiseshell handle with imitation pearls.

Seashells have been used as a form of currency by various cultures throughout history

Mother-of-pearl

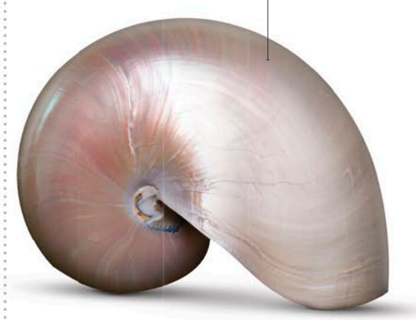
△ **Black pearl** in its shell of mother-of-pearl

Mother-of-pearl is the name given to nacre, the substance that lines the interior of some molluscs, but chiefly pearl oysters and freshwater pearl mussel shells. It is also the material from which pearls are formed. Prized for its iridescence, nacre is used decoratively in jewellery, clothing, architecture, and art. It is also of great interest to scientists due to its overlapping brick-like structure at a microscopic level, which allows impacts to be absorbed by dispersing them over a wide area – a property that could be applied to the creation of resilient materials.

Specification

Chemical name Calcium carbonate, calcium phosphate, amorphous silica | **Formula** $CaCO_3$, $Ca_3(PO_4)_2$, SiO_2 | **Colours** All | **Structure** Amorphous (prismatic, nacreous, crossed-lamellar, foliated and homogeneous) | **Hardness** 3.5 | **SG** 2.70–2.89 | **RI** 1.530–1.685 | **Lustre** Greasy to pearly | **Locations** Worldwide

Turban shell | **Rough** | South African turban shells such as this have been used in tribal art for millennia, and also occasionally as currency.

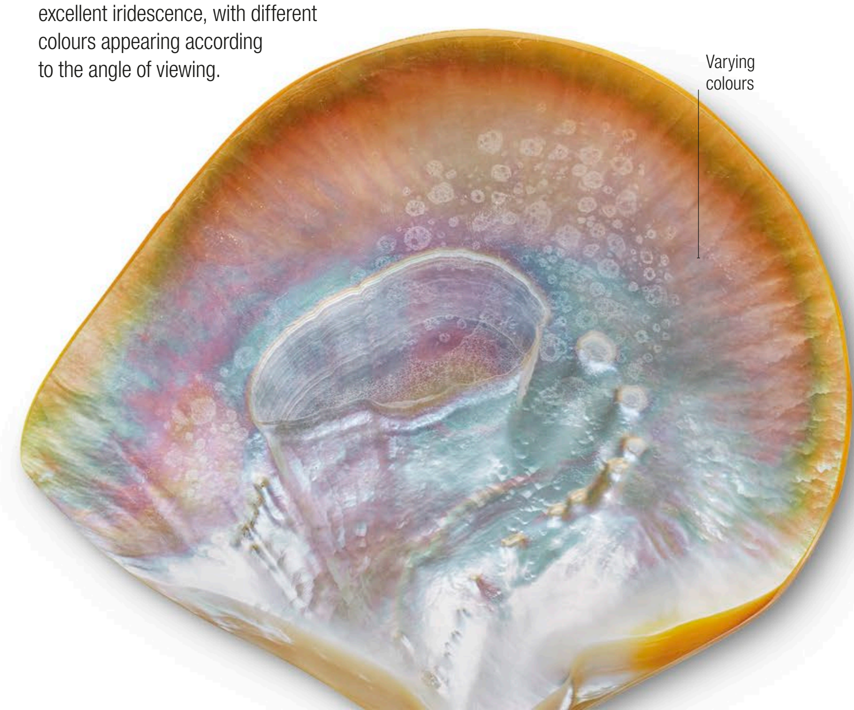


Nautilus shell | **Rough** | This stunning example of a large nautilus shell is coated with a fine layer of iridescent mother-of-pearl.

Mother-of-pearl beads | **Cut** | These flat oval beads show the natural shimmer and delicate finish that make mother-of-pearl such a popular decorative material.

Mother-of-pearl pendant | **Set** | This fanciful pendant in the shape of a window consists of mother-of-pearl, synthetic sapphire, and diamond.

Nacreous shell | **Rough** | This shell displays excellent iridescence, with different colours appearing according to the angle of viewing.



Art in Asia

Mother-of-pearl and lacquer

In various Asian cultures between the 8th and 19th centuries, craftsmen produced exquisite lacquered mother-of-pearl decorative pieces. These ranged from small boxes to large screens, and featured designs illustrating various religious or cultural themes. Nacreous shells were boiled and cut into pieces to form the designs. The craftsmen then coated the pieces with many layers of lacquer, a form of resinous tree sap that hardens to a protective, plastic-like finish.

Lacquer panel This Shibayama (inlay) piece features mother-of-pearl figures of a man and boy in rural Japan.

The collector... might be likened to a child who cries for the moon

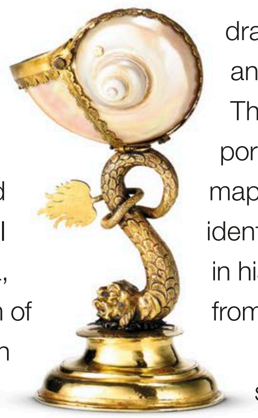
Baron Ferdinand **Rothschild**

Nautilus shell cup | Assembled c.1550 | 26.1 x 17 x 10.3cm (10¼ x 6¾ x 4in); 845g (1¾lb) in weight | Engraved nautilus shell, silver-gilt mounts

Nautilus **shell cup**

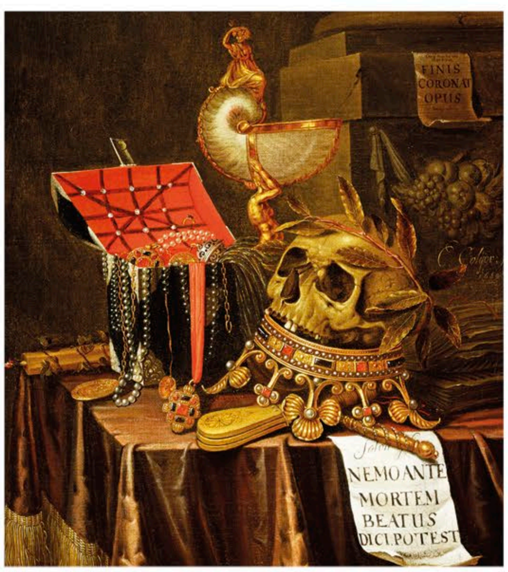
△ **Cutaway** of a nautilus shell showing internal chambers

This exquisite object is one of the greatest treasures in the Waddesdon Bequest, a collection of artefacts owned by Baron Ferdinand Rothschild. It consists of a beautiful chambered nautilus shell from Asia, transformed into a goblet in the form of a grotesque sea monster by Western craftsmen. The shell probably came from Guangzhou, China, where its surface had already been decorated with engravings of dragons. In Europe, this type of shell was an exotic novelty only available from the early 16th century, when the Portuguese began trading with Guangzhou. The identity of the Western artist or artists who worked on it is unknown, but experts believe that the work orginated in Padua, Italy. The decoration of the cup reflects its nautical origins as well as its cultural influences: in Chinese mythology, dragons lived in undersea caverns and were revered as rain-bringers. The beast is also similar to those portrayed on contemporary European maps, while the boy is Hercules – identifiable by the serpent that he killed in his cot – who later rescued a maiden from a sea monster.



Example of a German nautilus shell cup set in silver gilt, c.1700

Items of this kind were much sought after by Renaissance connoisseurs, who displayed them in their "Cabinets of Curiosities". These were treasure stores of lavish or unusual objects, which were designed to underline the wealth, learning, and worldliness of the collector. The cup's owner, Baron Rothschild, aimed to revive this idea with the New Smoking Room, which he built at his home, Waddesdon Manor. Here, he liked to astound his business associates by showing them his amazing collection of antiques after dinner. Rothschild later donated the contents of the room to the British Museum, on condition that the collection was kept intact.



"Vanitas" still life from 1689 showing a nautilus cup among other luxury possessions. The painting symbolized the transience of wealth

> These… are an **extraordinary** way of **mapping the world**
>
> Edmund **de Vaal**
> Artist and writer, describing the objects in the Waddesdon Bequest

Key dates

1513–2015

1500

- **1513** Jorge Álvares lands at Guangzhou. The Portuguese establish a monopoly of trade with Europe

1550

- **c.1550** European goldsmiths add the mounts to the shell
- **c.16th century** Chinese artefacts begin to become popular in Europe

1600

Baron Ferdinand Rothschild

1800

1850

- **1874–89** Baron Ferdinand Rothschild builds Waddesdon Manor
- **1891–96** The New Smoking Room is created at Waddesdon to house the Baron's collection
- **1898** In the Waddesdon Bequest, Ferdinand Rothschild donates around 300 objects to the British Museum

1900

2000

- **2015** A brand new gallery devoted to the Waddesdon Bequest opens at the British Museum

2050

HIGH SOCIETY

European aristocrats had always been the primary patrons of luxury jewellery houses, but in the 20th century, with Europe ruined by war and political upheaval, jewellers turned to the new big spenders: the stars, socialites, and heiresses of America. These new clients not only had big budgets, but creative vision, too, since many of the super-rich buyers of fine jewellery were also trend-setters. Jeanne Toussaint was head designer of luxury jewels at Cartier from 1933 onwards, attracting commissions from some of the leading society women of the day: Wallis Simpson was a devoted client (see pp.224–25), as was Barbara Hutton, heiress to the Woolworths stores.

Rivalling Cartier and other traditional jewellery houses, geologist Harry Winston founded his own jewellery workshop in New York in 1932, and soon made a name for himself with his jaw-dropping gems. In 1944, he became the first jeweller to lend diamonds to an actress for the Academy Awards (Oscar-winner Jennifer Jones), thus securing his name among the stars of Hollywood and high society. Other famous clients included Richard Burton and Elizabeth Taylor (see p.297), and Jackie Kennedy.

People will stare. Make it worth their while

Harry **Winston**
Jeweller

King of Diamonds Harry Winston appealed to the women of American high society by sourcing spectacular gems and setting them in designs that would maximize their brilliance. His philosophy – to let the gemstones dictate the design – set the standard for high-end jewellery in the 1930s.

Lid of an effigy jar, showing a Toltec warrior of the Coyote order | 10th to 12th century CE | 5¼ in (13.5 cm) tall | Plumbate-ware pottery, mother-of-pearl, bone

Mother-of-pearl coyote

△ **Quetzalcoatl**, the Mesoamerican god of wind and learning

This fascinating and striking object is a lid for an effigy jar (a vessel styled as human or animal) from the Toltec civilization of Mesoamerica (c.900–c.1150 CE). According to one theory, the lid portrays the god Quetzalcoatl with human features, but it is more widely thought to represent a Toltec warrior's helmet, which imitated a coyote's head and had an opening for the warrior's face between its jaws.

The lid displays intricate craftsmanship: it is modelled in clay and inlaid with carved mother-of-pearl and bone. The helmet it depicts is that of the Coyote order, one of the military classes of the Toltec, which included the Eagle and Jaguar, among others. Such a helmet indicated a degree of military rank, while also signifying a state of existence between the material world and the animal spirit world. Warriors also dressed in imitation of the animal's body.

The artefact was found in Tula (in modern-day Mexico), once the capital city of the Toltec Empire. The Toltec, who predated the Aztec, were a warlike people who dominated the region through military force. Religion played an important role in their lives, and human sacrifice to appease the gods was a key component of worship. Evidence of this at Tula includes a *tzompantli*, a skull rack for displaying the heads of sacrificial victims. In addition, three *chacmool* statues were found – reclining warrior figures clutching bowls intended to receive human hearts and other sacrificial offerings for the gods.

Portrait of a Native American man wearing a coyote head dress – the animal remained a powerful symbol for many cultures

Chacmool statue from the Toltec era. The Toltec religion included sacrifice, and these statues were made to hold human organs for the gods

Key dates

250 CE–1970

0

250–950 CE The Classic Maya Period occurs, predating the Toltec

c.900–c.1150 CE The Toltec civilization dominates in Mesoamerica, during which time the effigy vessel lid is crafted

935–47 CE The legendary ruler of the Toltecs, Ce Acatl Topiltzin, is born. He later also uses the title Quetzalcoatl

1000

1100

c.1150 The Toltec capital of Tula is abandoned and destroyed

1156–68 The remaining Toltecs flee Tula and settle at Chapultepec on Lake Texcoco

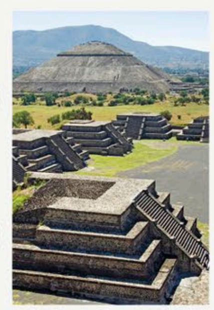
1200

c.1345–1521 The Aztecs, who revere and claim descent from the Toltecs, are the new power in Mesoamerica

1500

Toltec statue at Tula

1900



The ruins of the Toltec city of Tula

1950

1950–70 Archeological work identifies Tula as a Toltec city

2000

> **The Toltecs of tradition were chiefly remarkable for their intense love of art**
>
> Lewis **Spence**, author

Jet

△ **Sliced lump of jet** showing wood grain

Jet is a type of lignite made from fossilized, compressed driftwood from the Araucariaceae family of trees – Chile pine, also known as monkey puzzle tree. Jet is composed of organic matter and, like coal, is readily flammable. Its colour – jet black – never fades, and its polished surface can be used as a mirror, as it was in medieval times. Like amber, when jet is rubbed it produces an electric charge, a property that made it popular as a talisman and earned it the name "black amber". The best quality jet is found in Whitby, UK.

Specification

Chemical name Carbon | **Formula** C | **Colours** Dark brown, black, occasional brassy inclusions of pyrite | **Structure** Amorphous | **Hardness** 2.5–4 | **SG** 1.30–1.34 | **RI** 1.66 | **Lustre** Waxy | **Streak** Black to dark brown | **Locations** UK, Switzerland, France, USA, Canada, Germany

Rough

Jet block | This piece of high-quality jet shows the characteristic semi-metallic lustre found only in the finest and densest forms of the gem. The lustre is visible in this example both on its natural wood-textured surface and on its flat-sawn ends.

Raw jet | This piece of beach-recovered jet – a common way of finding it – has a slightly brownish cast and shows some of the original wood-grain structure.

Whitby jet | Showing healed natural fractures, this piece of raw jet comes from Whitby on the northern coastline of the UK, which is famous as a source of jet.

Cut

Oval cabochon | This oval jet cabochon has been polished with a number of flattened surfaces, giving it an appearance that almost looks faceted.

Jet bead | This antique jet bead, which was originally hand-faceted and drilled, has cracked over time due to the release of internal stresses created by cutting it.

Fashion for mourning

Jet and mourning jewellery

Jet has been in use since the Bronze Age, but saw a huge resurgence during the Victorian era, largely due to Britain's Queen Victoria, who, grieving for her husband Albert, popularized the wearing of jet mourning jewellery. Whitby jet was also the only jewellery permitted at court, and the fashion soon spread to other parts of society, causing a surge in popularity.

Queen Victoria Britain's popular monarch played a part in the vogue for jet jewellery during her reign.

Settings

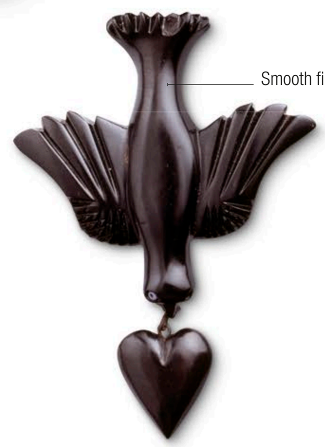
Victorian earrings | The deep and detailed cuts on this pair of Victorian jet earrings fashioned as flowers illustrates the gem's suitability for carving.

Necklace | This modern necklace has highly polished, hand-faceted beads and a freeform drop, all showing the semi-metallic lustre of fine jet.

Earrings | The flowing shape of the 15-karat-gold-mounted drops on these fabulous Victorian earrings illustrates the fine carving qualities of jet.

Rose carving | The intricacy of the carving on this jet brooch shows not only the skill of the craftsman, but the beauty of the mineral as a medium.

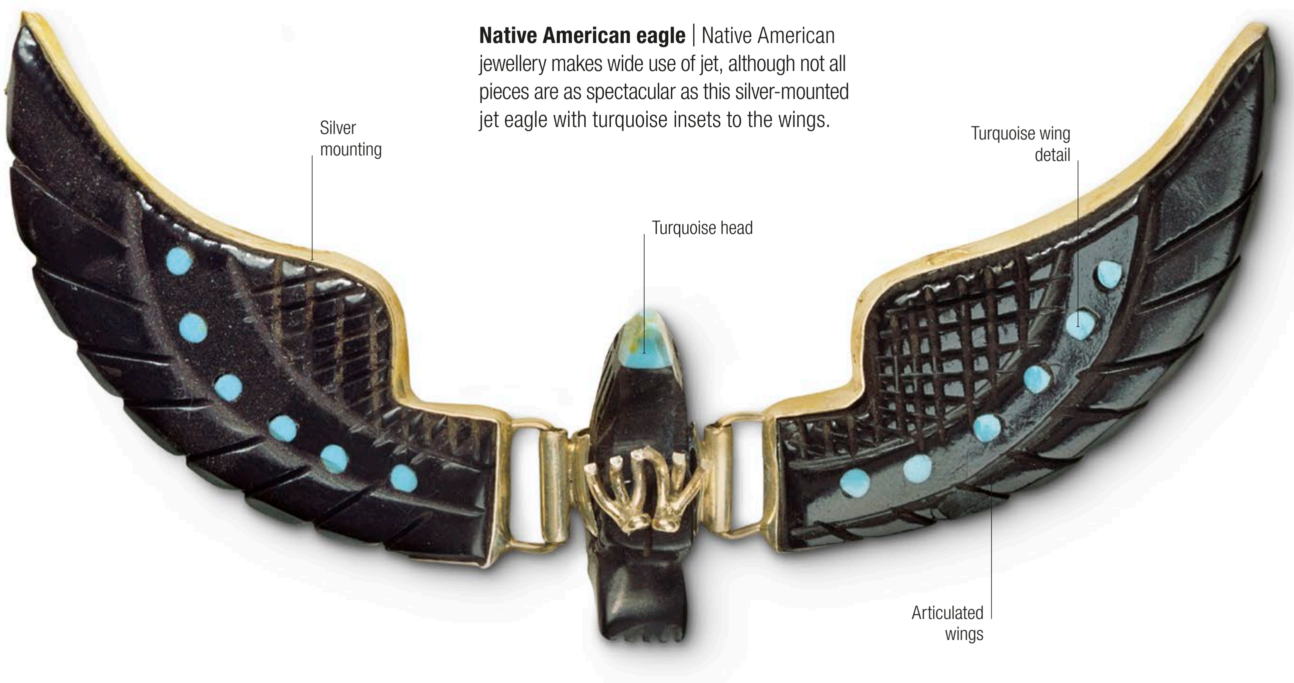
Trefoil brooch | A Roger Jean Pierre design, this piece features faceted jet rectangles set off by Swarovski hot pink and opaque pink stones in silver gilt.



Pendant | This three-dimensional jet pendant features a dove carrying a heart in its beak. The fine finish demonstrates the smooth texture that can be imparted by polishing.

Bead necklace | The beads on this Turkish jet necklace display a rounded, bi-conical form, which highlights their brilliant polish. Jet is often used in necklaces.

Native American eagle | Native American jewellery makes wide use of jet, although not all pieces are as spectacular as this silver-mounted jet eagle with turquoise insets to the wings.



Jet has been used in the making of decorative objects since the Neolithic period 10,000 years ago

Copal

△ **Translucent** golden copal nugget from New Zealand

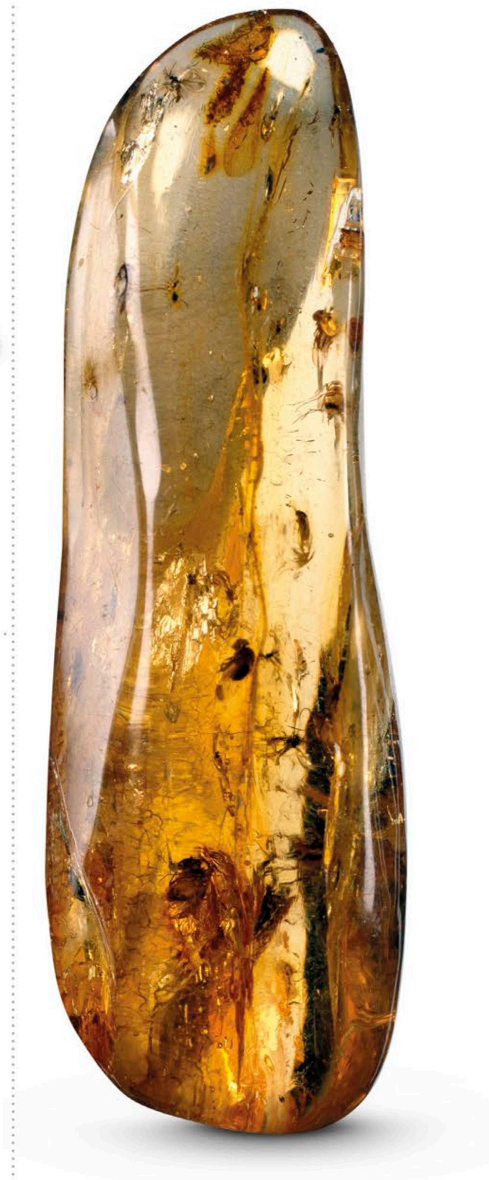
Copal is semi-fossilized tree resin from the copal tree, *Protium copal*. It differs from amber, which also results from tree resin, in that it is far younger – copal is less than 100,000 years old, while amber may be millions of years in the making. For this reason, copal is more common and thus cheaper, although it is often used to imitate amber. Copal has historically been burned as incense, especially in offerings to the Mayan gods in Mesoamerica. Europeans later valued it as an ingredient in wood varnish, particularly during the 19th and 20th centuries.

Specification

Chemical name Copal gum | **Formula** $C_{10}H_{16}O$
Colours Light lemon yellow to orange | **Structure** Amorphous | **Hardness** 2–3 | **SG** 1.05–1.10 | **RI** 1.54
Lustre Resinous | **Streak** n/a | **Locations** Malaysia, Philippines, Africa, Colombia, New Zealand

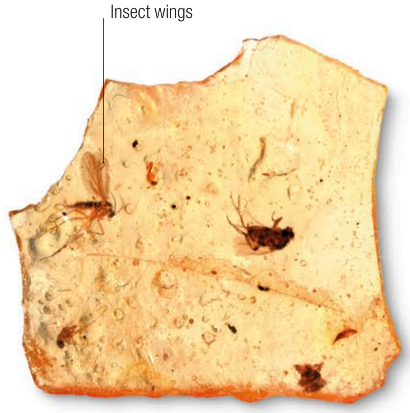
Forest-floor copal | **Rough** | The flattened, globular shape of this example of copal is the result of its original resin forming a pool on the forest floor.

Gemmy copal | **Colour variety** | This group of gemmy, light to dark honey-coloured copal pieces shows a variety of different shades and colours.



Dominican copal | **Cut** | This striking piece of polished copal from the Dominican Republic is also populated with trapped flies, spiders, and midges.

Copal is still burned as a form of incense in sweat lodge ceremonies in Mexico and Central America



Copal slice | **Rough** | This thin slice of copal contains a few well-preserved insects,and is notable for its country of origin, Madagascar.

Trapped insects | **Cut** | This polished copal example is dotted with trapped insects, pollen, and seeds, in a similar manner to pieces of amber.

Anthracite

△ **Specimen** of anthracite showing its semi-metallic lustre

Anthracite is the purest, most carbonized type of coal, consisting almost entirely of carbon. Like bituminous coal, it is composed of organic matter, but is older and much more highly compressed, and does not leave behind any residue when touched. It is used in beads and carvings, although its main use is as a fuel – though difficult to ignite, once lit it produces a lot of heat and burns slowly. Anthracite fires combust with a small blue flame that is smokeless, making it a good fuel for indoor use, but its expense means it is less widely used on an industrial level.

Specification

Chemical name Anthracite | **Formula** $C_{240}H_{90}O_4NS$ **Colours** Metallic black | **Structure** Amorphous | **Hardness** 2.75–3 | **SG** 1.4 | **RI** 1.64–1.68 | **Lustre** Sub-metallic **Streak** n/a | **Locations** Russia, Ukraine, North Korea, South Africa, Vietnam, UK, Australia, USA

Compact form | **Rough** | The typical density of anthracite can be seen in this specimen, as can its characteristic, near-metallic, lustre.

Bright lustre | **Rough** | The irregular surface of this specimen of anthracite shows an unusually bright lustre and inclusions of rock groundmass.

Blocky breakage | **Rough** | Because anthracite is hard and brittle, its surface tends to break in sharply angled blocks, as in this specimen.

Contrasting specimens | **Rough** | The upper specimen is bituminous, or ordinary household, coal, while the lower specimen is anthracite.

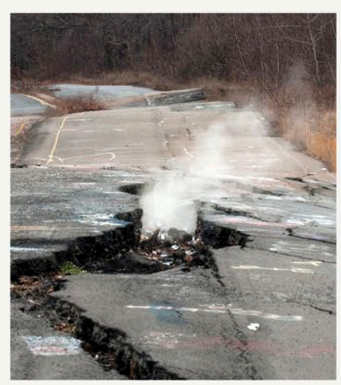
Weathered anthracite | **Rough** | When exposed to weathering, the outer layers of anthracite blocks oxidize and deteriorate, as in this specimen.

Polished anthracite | **Cut** | This irregularly shaped piece of anthracite is polished to a sheen, showing how it can sometimes be used as a jet-substitute.

Slow burn

The Centralia mine fire

An underground fire has been burning for decades in an anthracite mine in Centralia, Pennsylvania, USA. The fire started in 1962, and came to a head in 1981 when a 12-year-old fell into a 46m (50yd) sinkhole caused by the fire, which opened up beneath him (he survived, hauled out by his cousin with a rope). The fire is still burning and Centralia is now a ghost town.



The Centralia fire Anthracite burning in the old mine can be seen here breaking through the surface of the ground.

Amber

△ **Polished amber** containing a preserved spider

The fossilized tree resin from a prehistoric pine tree that was common in the Baltics, amber is also found in a few other locations. True amber is around 25–60 million years old, and specimens can function as tiny time capsules, preserving long-extinct plants and insects – these are highly valued. The Greeks noted how amber becomes charged when rubbed with fur or wool; the word for amber in Greek, *elektron*, is the root of the word "electricity". Amber has a low density and can float on salt water, so it is often found along seashores.

Specification

Chemical name Oxygenated hydrocarbon | **Formula** Organic
Colours White, yellow, orange, red, brown, blue, black, green
Structure Amorphous | **Hardness** 2–2.5 | **SG** 1.05–1.09
RI 1.54 | **Lustre** Resinous | **Streak** White | **Locations** Eastern Europe, Dominican Republic, USA

Rough

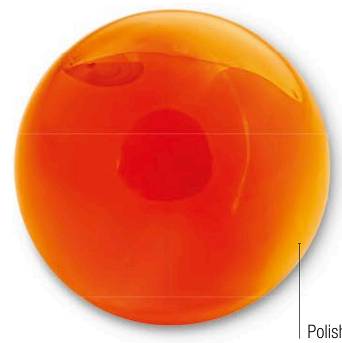
Amber rough | In common with many amber roughs, the luminously transparent interior of this piece of amber is visible behind its opaque surface.

Broken rough | This amber nodule has been broken, revealing the fine-quality amber within the dull, textured exterior that is typical of amber in its natural state.

Clear amber | This piece of clear amber contains a preserved insect and other inclusions. It has been smoothed to a natural finish by the elements.

Polished specimen | Preserved insects are clearly visible in this piece of amber from Playa del Carmen, Mexico. Its smooth surface reveals its inner transparency.

Cut



Amber sphere | This finely polished spherical amber bead shows a deep orange colour and opaque texture. It originates from the southeastern coast of the Baltic.

Faceted amber | Amber is rarely faceted because of its extreme fragility. The cutter of this 2.36-carat emerald-cut green amber stone was unusually skilful.

Settings

Amber necklace | This substantial necklace is composed of elongated, polished beads in a fan pattern, and features many small inclusions. Amber's light weight makes it suitable for use in large jewellery pieces such as this.

Aquatic pendant | Featuring an amber cabochon set in silver, this German pendant from around 1930 was made by Louis Vausch, who was known for his use of fish motifs.

Earrings | These two teardrop-shaped amber cabochons with inclusions have been framed in silver and suspended in a pair of dangle earrings.

Amber ring | The centrepiece of this silver ring is a fine piece of gem amber, showing numerous trapped air bubbles and inclusions of organic matter.

Grieving gods

Amber's mythological past

The ancient Greeks made reference to amber in one of their myths. Demi-god Phaethon lost control while driving his sun-god father's fiery chariot, scorching the Earth's surface. To stop him, Zeus struck him dead with a thunderbolt, causing his body to fall into a river. The river's nymphs buried Phaethon's body on the shore, and his sisters, the three Heliades, wept over it night and day. Eventually, their grieving bodies took root as trees, and their tears hardened into droplets of amber.

Phaethon in Apollo's chariot
This Greek vase depicts the story of Phaethon and the Heliades.

Amber Room (replica) | 1701–16 (original) | More than 5.4 tonnes (6 tons) (original panels) | Wall panels of carved amber, backed with gold leaf, and mosaics made with quartz, jasmine, jade, and onyx

Russian Amber Room

△ **Prussian coat of arms** on the south wall

The fate of the Amber Room is one of the great mysteries of modern times. This spectacular chamber was originally commissioned by King Friedrich I of Prussia in 1701. It consisted of a series of richly carved amber panels adorned with semi-precious stones and Florentine mosaics, depicting the five senses. A German sculptor, Andreas Schlüter, and a Danish amber specialist, Gottfried Wolfram, collaborated on the work. In 1716, the panels were presented to the Russian Tsar, Peter the Great, after he admired them during a state visit. He installed them in St Petersburg where they remained until 1755, when the Tsarina Elizabeth had the room enlarged and redesigned so that it would fit into her palace.

The Amber Room remained a prized possession of the Russian state until World War II, when looting German forces dismantled it. The stolen panels were packed into 27 crates and carried off to Königsberg Castle on the Baltic coast. The trail ends there. The panels may have been destroyed by Allied bombing, or by a fire in the castle – in either case, they had disappeared by the end of the war. A replica of the room was completed in 2003, in St Petersburg, Russia.

Crown-shaped detail carved in amber

Treasure hunters have never given up the search for the original panels, and fanciful theories abound. Some believe the Nazis buried the loot in an underground bunker; others claim the remains of Hitler were interred with the panels. Periodically, there have been claims of its rediscovery. In 2015, Polish treasure hunters located an armoured train believed to be packed with Nazi booty, buried in tunnels near Ksiaz Castle in Poland. The same year, a German search team explored old copper mines at Deutschneudorf, near the Czech border. Neither find came to anything, and the hunt goes on.

Rococo clock with a highly decorative base mounted on an amber-inlaid table, in the rebuilt Amber Room

> **The Amber Room has enormous emotional significance for both Germany and Russia**

Friedrich **Spath**, chairman of Ruhrgas, corporate donors to the reconstruction project

Key dates

1701–2003

1700

1701 King Friedrich I of Prussia commissions the Amber Room

1709 The completed panels are installed in Charlottenburg Palace, Berlin

1716 The King of Prussia presents the room to Peter the Great of Russia to cement their alliance

1750

1755 Tsarina Elizabeth enlarges the room and has it transferred to the Catherine Palace near St Petersburg

1800

Friedrich I of Prussia

1850

1900

1941 Nazi troops invade Russia and steal the panels, spiriting them away to Königsberg Castle

1944 Allied bombing inflicts heavy damage on the castle, perhaps destroying the Amber Room

1950

1979 Work starts at the Catherine Palace on a faithful replica of the room

1979 German police discover a mosaic that may have come from the Amber Room

2000

2003 The German Chancellor Gerhard Schröder and President Putin of Russia jointly open the new Amber Room

2015

Coral

△ **Red coral** from the Mediterranean sea

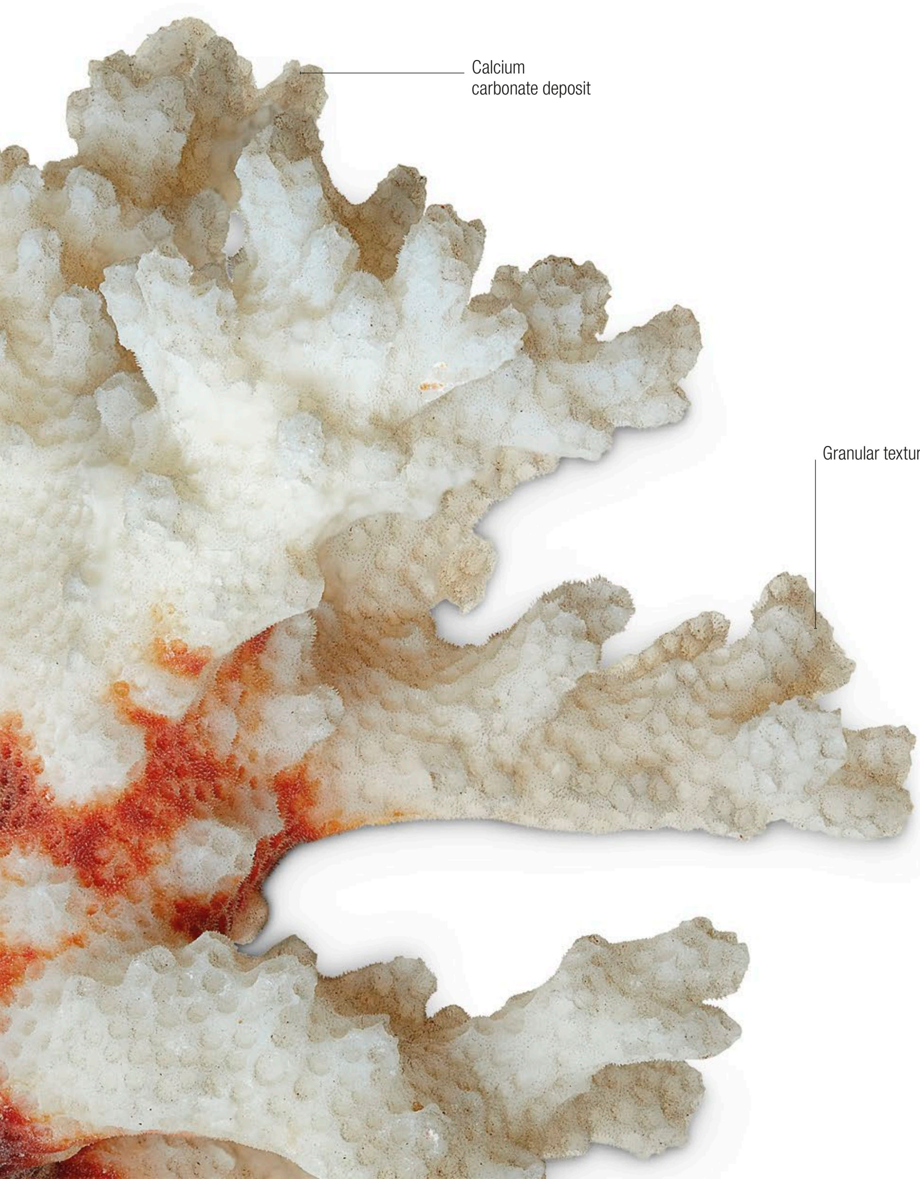
Precious (red) coral includes species such as *Corallium rubrum* and *Corallium japonicum* and is found in tropical and semi-tropical waters. Precious coral is valued over other types of coral for its toughness and attractive pink to red hues. Coral is the exoskeleton of the marine polyp – a small creature that secretes calcium carbonate to form branchlike structures. As the branches tend to be fine and narrow, material is usually sourced from the thicker forks. Coral has been used decoratively since prehistoric times.

Specification

Chemical name Calcium carbonate | **Formula** $CaCO_3$
Colours Pale pink (angelskin), orange, red | **Structure** Crystalline
Hardness 3.5 | **SG** 2.6–2.7 | **RI** 1.48-1.66 | **Lustre** Vitreous, waxy | **Streak** White | **Locations** Warm seas around Japan and Malaysia, Mediterranean, African coastal waters

Rough

Natural coral | The sections of coral most useful to jewellers are the thickest parts where two branches meet, or the widest part of a limb. The scale is often small – this piece of raw coral is about 6cm (2¼in) in width.



Red coral slice | This coral cross-section reveals the intricate, banded structure of the material. The lustre is dull when harvested, but polishing makes it shine.

Branch of red coral | The longitudinal striations (grooves) give this natural piece of uncut coral a typical pattern that resembles natural wood grain.

Cut

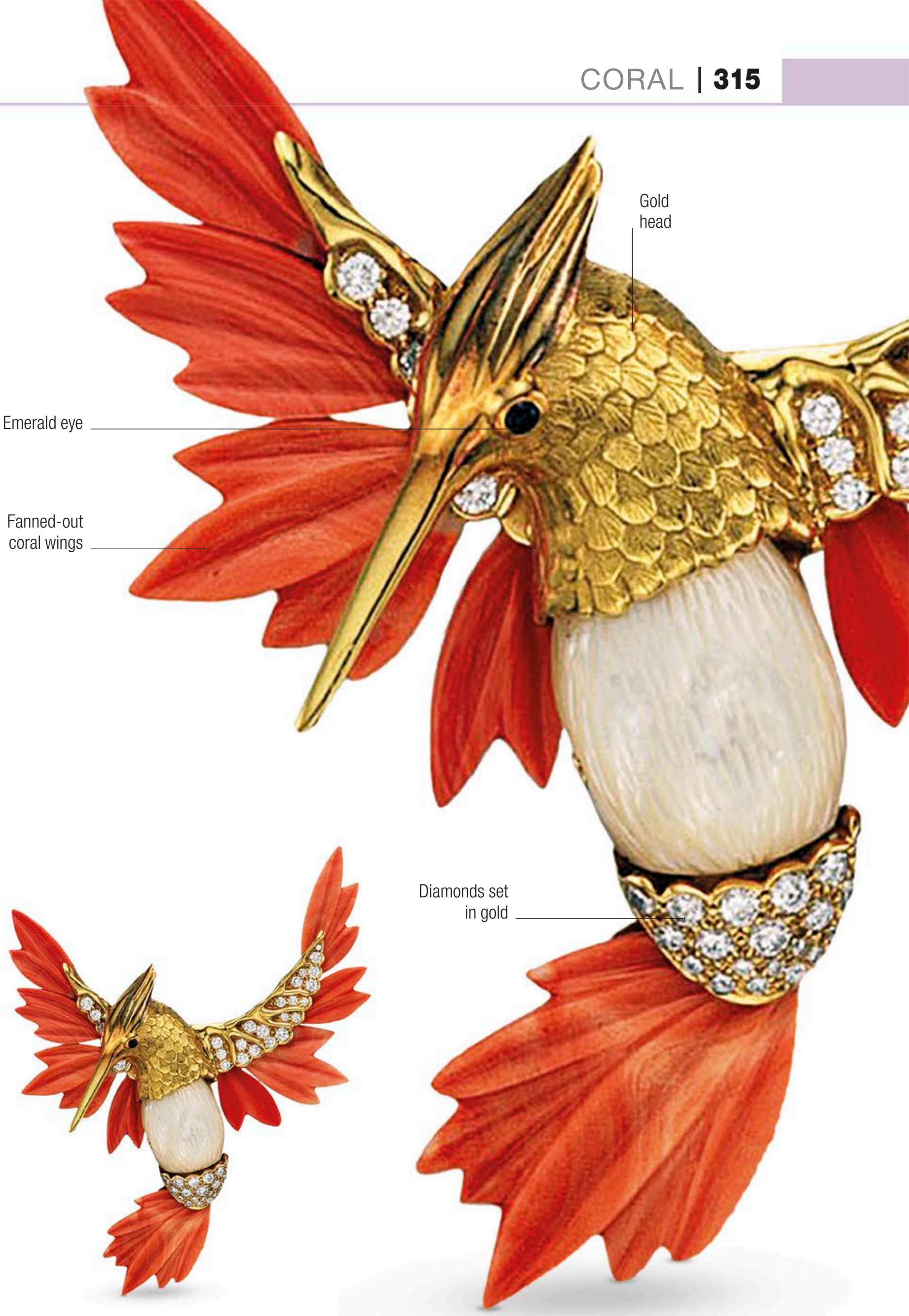
Coral oblong cabochon | Because it is soft and opaque, coral is often cut *en cabochon*. Then it can be polished and the colour shown off to its advantage.

Oval cabochon | The simple shape and cut emphasize the colour of this cabochon, often referred to as "angelskin", a term that can apply to hues from pale pink to salmon.

Settings

Coral ring | For the centrepiece of this gold ring, angelskin coral was carved into rose blossom petals. The flushes of colour mimic the tints of a real rose.

Coral set earrings | A specimen of deep red coral has been delicately carved to create matching rose shapes for these small stud earrings.



Maple-leaf pin | This gold-plated pin is set with oval and teardrop-shaped coral cabochons of differing sizes slotted within the serrated edges of the "leaf".

Coral carving | Coral is associated with the safeguarding of children, and this miniature carving may have been a gift intended to bring protection to the wearer.

Hummingbird brooch | This hummingbird, with coral wings and tail outstretched in flight, was produced c.1975 by the jewellers Kutchinsky. It also incorporates diamonds, gold, mother-of-pearl, and emerald.

In the classical world, coral was worn as an amulet to protect against the evil eye

Snake brooch | Designed as a stepped coral snake, the carving of this late 19th-century comprises 30 sections, intertwined with a scrolling branch.

Blood of the Gorgon

Gory beginnings

In Greek mythology, the hero Perseus beheaded Medusa, the Gorgon who turned people to stone by looking at them. Perseus then used Medusa's severed head to petrify a sea monster, Cetus – Medusa's gaze in death was still lethal. Afterwards, he set the head down on a riverbank where the blood ran into the water, transforming seaweed into red coral. *Gorgeia* – after Gorgon – is the Greek word for coral.

Looks can kill This coral carving, from the 2nd or 1st century BCE, Bactria (in present-day Afghanistan and Tajikistan), is of Medusa.

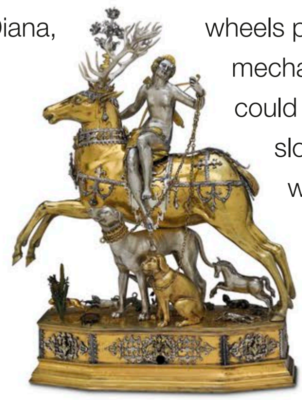
Diana with stag | 17th century | 32.5cm (14in) high | Silver parcel-gilt, coral, repoussé

Diana with stag centrepiece

△ **Altarpiece** by Matthäus Walbaum of Augsburg, Bavaria

This statuette depicting Diana, goddess of the hunt, is not merely a decorative centrepiece, but also a drinking vessel and automaton used in early 17th-century party games.

The statuette, 32.5cm (14in) in height, is made from silver parcel-gilt (partially gilded) with repoussé work, and red coral forming the stag's antlers. It depicts the Greek goddess Diana riding a stag, accompanied by two hunting dogs. This example was likely to have been made by goldsmith Matthäus Walbaum of Augsburg, Bavaria, or one of his circle. The base of the statuette once contained wheels powered by a clockwork mechanism, now missing, which could be wound with a key in a slot on the side. The automaton was placed on the table at dinner parties, wound up, and then released, at which point it wheeled off, making many arbitrary turns before stopping in front of one of the guests. The stag, which is hollow, would have been filled with wine by the host and the guest was required to drain it, removing the head and using it as a cup.



Another automaton depicting Diana, Eltz Castle, Germany

These wind-up sculptures proved popular in the 1600s and 1700s, and "Diana on a stag" was a favourite theme of the renowned Augsburg goldsmiths; around 30 such statues survive, all produced by three of the city's goldsmiths. Walbaum probably created the earliest example. Other variations of Diana from this period, such as the automaton at Eltz Castle, Germany, reserved the stag for the men, with a smaller, hollow hound for the ladies. Chains attached to the cups meant participants had to drink in close proximity to one another.

Statue of Diana, which stood in Madison Square Garden, New York, until 1925. The day it was removed, it attracted crowds of onlookers

Key dates

1590–2000s

1500

- **1590** Matthäus Walbaum is master goldsmith at Augsburg, Germany
- **1600** "Diana with stag" automaton created

1600

- **1600s** Augsburg goldsmiths create numerous other "Diana with stag" automatons
- **1632** Matthäus Walbaum dies

1700

Silver and gilt-copper elephant automaton clock, Ausburg, c.1630

1800

German stamp showing a Rubens painting of the goddess Diana

1900

2000

- **2000s** "Diana and the stag" resides at the treasury of Munich Residence, Germany

One of the **most productive goldsmith's workshops** in Augsburg

Grove Encyclopedia of Decorative Arts on Matthäus Walbaum's workshop

Peanut wood

△ **Slice of peanut wood**, 30cm (12in) long

Also called Teredo wood, peanut wood is a petrified wood with white ovoid markings on its surface, giving it the appearance of peanut brittle. It comes from a conifer that grew around 120 million years ago, mainly in Australia. Its curious appearance is the work of ancient marine animals. A wood-eating clam, *Teredo*, tunnelled into the conifer driftwood, which later sank to the seafloor. White sediment from the shells of tiny plankton then settled over the wood, filling the boreholes with concentrated levels of silicate and creating white tubes when the wood petrified.

Specification

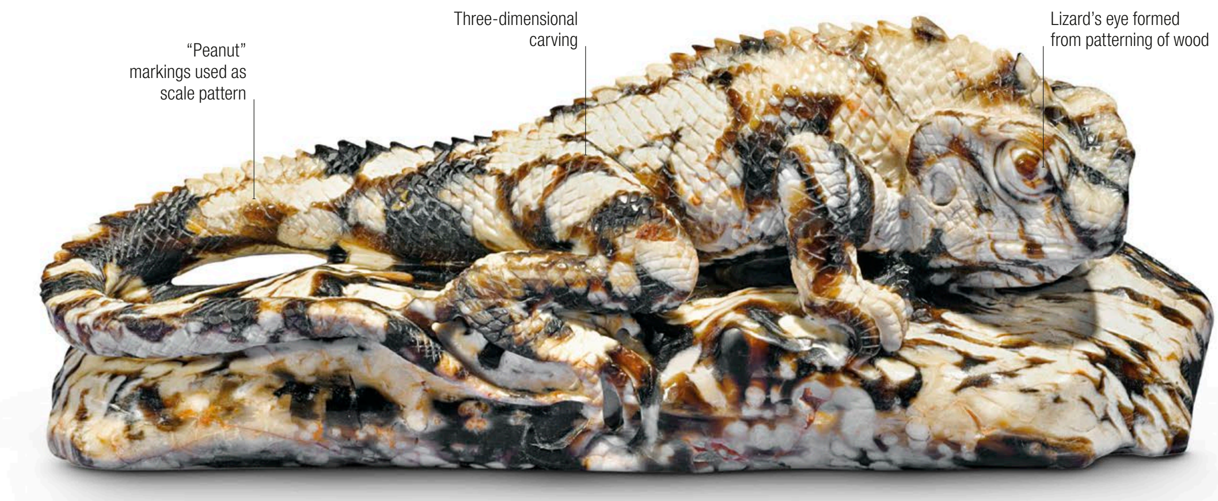
Chemical name Silicon dioxide (white areas), iron oxide (coloured areas) | **Formula** SiO_2 | **Colours** White markings on brown, grey, green | **Structure** Amorphous | **Hardness** 6.5–7 | **SG** 2.58–2.91 | **RI** 1.54 | **Lustre** Vitreous **Location** Australia

Uncut peanut wood | **Rough** | This chunky piece of peanut wood rough comes from the Gascoyne region of Western Australia. It has an even contrast of light and dark areas.

Round-cornered cabochon | **Cut** | This rectangular cabochon of peanut wood has been cut along the "peanut" markings to highlight them.

Round cabochon | **Cut** | This circular gem has been cut to emphasize its unusual 3D-effect markings. The "peanut" shapes are especially evident.

Bracelet | **Set** | This silver bracelet is bezel-set with six Australian peanut wood cabochons and accented by a faceted smoky quartz that suits the colour scheme.



Lizard ornament | **Carved** | When its pattern is used artistically, as here, peanut wood is a carving medium to rival any. Because it is a form of chalcedony, it is hard and durable, and takes a good polish.

Ammolite

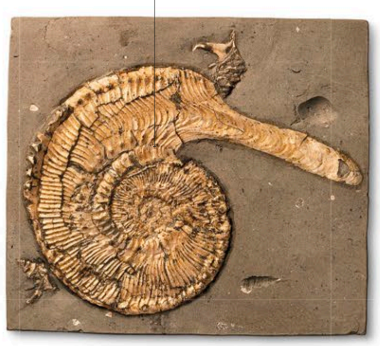
△ **Ammonite fossils** in an unusual grouping

Ammolite is the lining of the shell from the ammonite, a mollusc that became extinct roughly 66 million years ago, around the same time as the dinosaurs. Its iridescent colours cross the spectrum, but green and red are most common, with gold or purple being rarer. It is found in many parts of the world, but the best examples come from Alberta, Canada, where it is mined. The Native Americans of Alberta, the Blackfoot people, know it as Iniskin, or Buffalo Stone, and believed that it could attract buffalo near enough for them to be hunted.

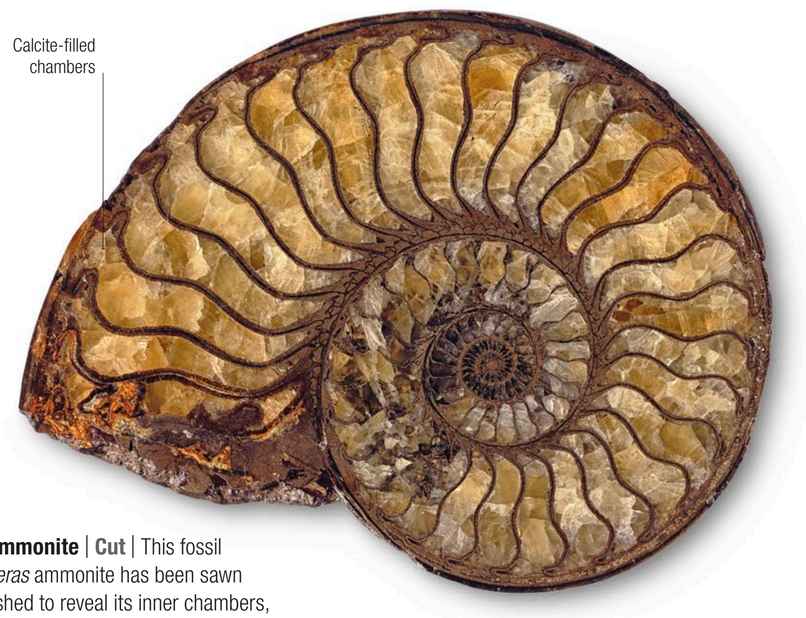
Specification

Chemical name Aragonite polymorph | **Formula** $CaCO_3$
Colours All spectral colours – red, orange, yellow, green, blue, indigo, violet | **Structure** Orthorhombic | **Hardness** 3.5–4 | **SG** 2.75–2.85 | **RI** 1.52–1.68 | **Lustre** Vitreous
Locations Canada, USA

Coiled ammonite | **Rough** | This fossil of the ammonite *Dactyliosarus* shows classic coiling and ribbing. It is from the Jurassic Period, up to 200 million years ago.



Unusually preserved specimen | **Rough** | This fossil ammonite *Kosmoceras duncani* was found in Jurassic Oxford Clay in England; it shows some fossilized soft tissue.



Sawn ammonite | **Cut** | This fossil *Oxinoticeras* ammonite has been sawn and polished to reveal its inner chambers, infilled with calcite.

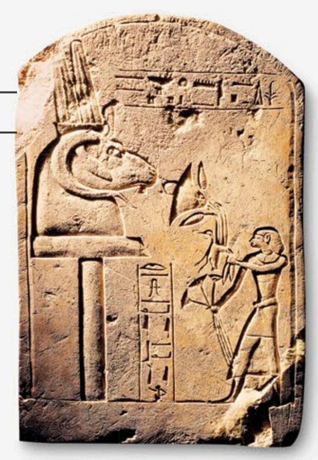
Ammolite | **Cut** | A section of the fossilized outer shell of an ammonite, this ammolite gem weighs 23.70 carats with a maximum length of 33mm (1¼ in).

Snakestone | **Carved** | Following the legend of St Hilda turning snakes to stone, modern lapidaries have started carving snakes' heads onto ammonites, as here.

Snake or ram

Animal links

Ammonite is named for its similarity in appearance to a ram's horn. The 1st-century CE Roman writer and natural philosopher Pliny the Elder called the fossilized molluscs *Ammonis cornua* ("horns of Ammon"), after the Egyptian god Ammon (Amun), who was usually represented with ram's horns. In medieval Europe, the fossils were called snakestones or serpentstones and were believed to be petrified snakes, the work of saints such as St Patrick or St Hilda of Whitby.



Egyptian god Ammon as a ram's head This stela (stone slab) would have served as a gravestone.

4

Rock gems and rocks

Moldavite

△ **Brilliant** oval-cut, faceted moldavite

Moldavites were formed 15 million years ago, when a meteorite struck near modern Ries, Bavaria, melting the local sandstone. The substance is a tektite, the name for minerals formed when large meteorites hit Earth: the terrestrial rock melts on impact, is splashed into the air, and quickly cools to form the glass-like substance. Tektites are found on most continents, but moldavite is local to the Ries impact point. It is typically olive-green to dull greenish yellow, and is found in sizes ranging from less than a millimetre to several centimetres across.

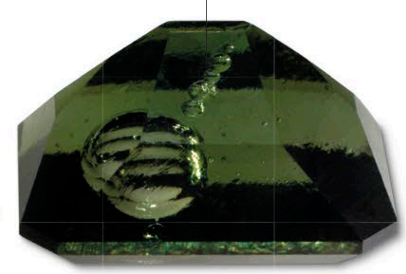
Specification

Chemical name Silicon dioxide | **Formula** $SiO_2(+Al_2O_3)$
Colour Mossy green, greenish yellow | **Structure** Amorphous
Hardness 5.5 | **SG** 2.40 | **RI** 1.48–1.54 | **Lustre** Vitreous | **Streak** n/a | **Locations** Germany, Czech Republic

Spindle shape | **Rough** | During the flight of molten moldavite through the air, it assumes a number of shapes, such as this elongated form, called a spindle.

Uncut moldavite | **Rough** | The substantial, chunky form of this moldavite rough suggests that it cooled extremely rapidly after being thrown from the meteorite crater on impact.

Dramatic form | **Rough** | Some moldavites were still fluid when they were flung from the crater, and as a result tend to assume frothy, "splatter"-like forms such as this.



Faceted moldavite | **Cut** | This particularly dark green moldavite gemstone has been faceted in a freeform shape, viewed here from the pavilion.

Excellent clarity | **Cut** | Certain moldavite gemstones are exceptionally transparent, such as this highly refractive, brilliant-cut example.

Moldavite takes its name from the town of Moldauthein in the Czech Republic

Horse head | **Carved** | The carver of this moldavite shaped in the form of a horse's head has left the natural surface of the mineral as the horse's mane.

Obsidian

△ **Tumble-polished** obsidian piece

Obsidian is a natural volcanic glass that forms when lava solidifies so quickly that mineral crystals do not have time to grow. Technically, obsidian can have any chemical composition, although it is usually the product of silica-rich magmas. It is typically jet-black; hematite (iron oxide) contained within it can result in red and brown varieties, and the inclusion of tiny gas bubbles can create a golden sheen. In snowflake obsidian, clusters of light-coloured, needle-like crystals of cristobalite on broken surfaces resemble snowflakes.

Specification

Chemical name Silicon dioxide | **Formula** Composed of SiO_2, MgO, and Fe_3O_4 | **Colours** Black, red, brown | **Structure** Amorphous | **Hardness** 5–6 | **SG** 2.35–2.60 | **RI** 1.45–1.55 | **Lustre** Vitreous | **Streak** White | **Locations** Europe, North America, South America, Australasia, Japan

Mexican obsidian | **Rough** | This gemmy, highly reflective piece of black obsidian originates from the central highlands of Mexico.

Snowflake obsidian | **Rough** | As this variety of obsidian cools, snowflake-like white crystals of cristobalite are formed, creating its distinctive appearance.

Rainbow obsidian | **Cut** | As with sheen obsidian (see right), rainbow obsidian contains small, oriented platelets, giving it an iridescence when polished.

Sheen obsidian | **Cut** | During its formation, platelets of other minerals form within the obsidian, giving it a sheen when polished, as seen here.

Cat carving | **Carved** | Although obsidian is brittle and glass-like, with careful carving, attractive ornaments can be produced from the material, such as this sculpture of a wistful cat in patterned snowflake obsidian. Its surface has been polished to a high shine.

Obsidian blades

Ancient cutting tools

When obsidian breaks, it can form an edge sharper than that of a steel scalpel. It was often used throughout antiquity to fabricate cutting tools and weapons, and was a prized material, widely traded across vast distances. It was used from the Stone Age onwards in civilizations including pre-Colombian Mesoamericans, ancient Egyptians, Native Americans, and others.

Obsidian spearhead and knife These blades originate from the Admiralty Islands off New Guinea from around 1900. They retain parts of their painted handles.

Limestone

△ **Pterodactylus fossil**, beautifully preserved in limestone

Limestone is largely made up of calcium carbonate and, depending on its formation, can be clastic, crystalline, granular, or massive. A sedimentary rock, most limestone forms in calm marine waters, occurring when marine organisms die and fragments of shell, skeletal debris, and coral break down into sediment. Minerals then cement the sediment together, turning it into limestone. It was used in many ancient carvings, and is regularly employed as a construction material, a base for roads, a white pigment or a filler in paints, plastics, and toothpaste.

Specification

Rock type Marine, chemical, sedimentary | **Fossils** Marine and freshwater invertebrates | **Major minerals** Calcite | **Minor minerals** Aragonite, dolomite, siderite, quartz, pyrite | **Colours** White, grey, pink | **Texture** Fine to medium, angular to rounded | **Locations** Worldwide

Ornately carved headdress

Veil with scallop detailing

Limestone statue | **Carved** | Finely detailed mortuary statues, such as this one from 2nd-century CE Palmyra, were carved throughout the Roman world. This high-relief bust of a woman is richly carved with necklaces, bracelets, brooches, and rings.

Surface contains fossils

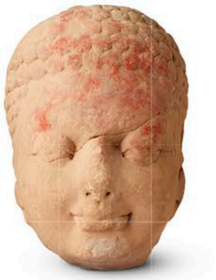
Fossiliferous rock | **Rough** | Limestone-bearing fossils such as this specimen containing bryozoans is often sawn and polished, and used as cladding for buildings.

Freshwater limestone | **Rough** | Limestone is generally formed in salt water, but it can also form in fresh water, as with this fossiliferous example.

Sphinx and base carved from one complete piece

Sphinx | **Carved** | Just like the Great Sphinx in Giza, this smaller version is also carved from limestone – a favourite carving medium in antiquity, when this sphinx was made.

Homeosaurus fossil | **Cut** | Fine-grained limestone provides the perfect environment for fossil preservation, as shown with this Jurassic Homeosaurus.



Sandstone

△ **Head of a reclining** Buddha statue carved in sandstone

Sandstone is found throughout the world and is one of the most common varieties of sedimentary rock. The tiny, sand-sized grains of mineral, rock, or organic material that make up its composition are reduced in size by weathering, and then compacted together over long periods of time. Mineral grains in sandstones are typically quartz or feldspar: these grains crystallize around the sand grains, cementing them together. Sandstone can be any colour, but is usually brown, yellow, red, grey, pink, or white; it has been used in carvings and architecture for centuries.

Specification

Rock type Continental, detrital, sedimentary | **Fossils** Vertebrates, invertebrates, plants | **Major minerals** Quartz, feldspar | **Minor minerals** Silica, calcium carbonate **Colours** Cream to red | **Texture** Fine- to medium-grained, angular to rounded | **Locations** Worldwide

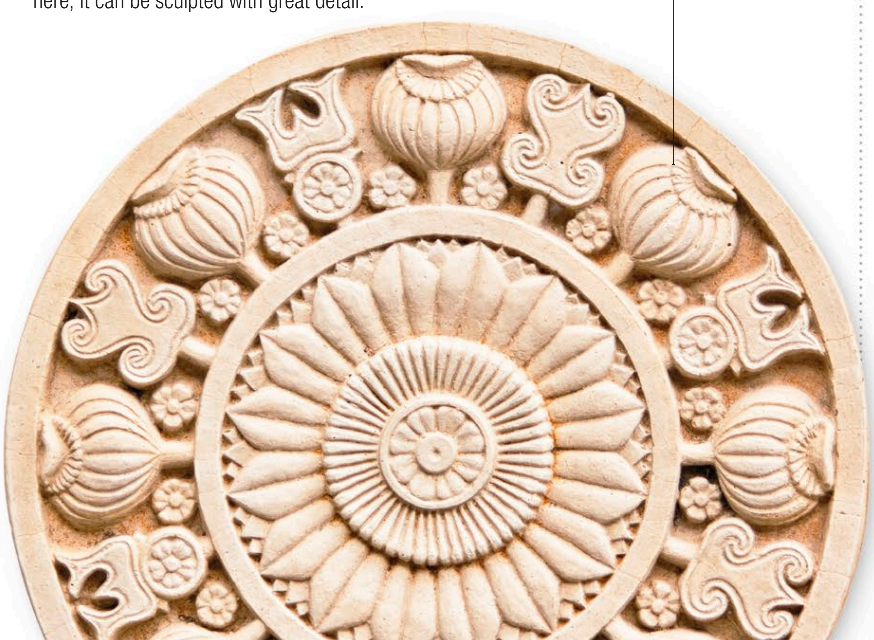
Grainy surface | **Rough** | The rough, textured surface of this piece of rust-red sandstone is coated with tiny individual sand grains.

Sandstone boulder | **Rough** | This sandstone boulder could be split along its horizontal bedding planes to produce fine carving material.

Layered sandstone | **Rough** | Sandstone with different-coloured layers can be sawn across the bedding to reveal sand "pictures", as seen in this specimen.

Indian statue | **Carved** | This intricately detailed, red sandstone carving from 1st–2nd-century CE India has been coated with gesso before being painted.

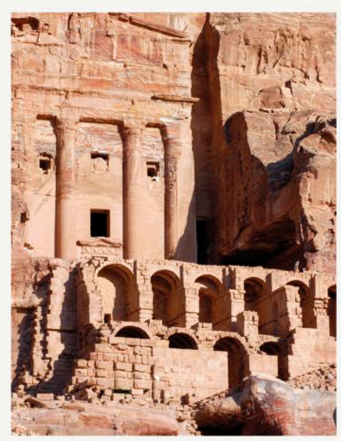
Lotus carving | **Carved** | Sandstone can vary in hardness and some material can be difficult to carve, but when fine-grained, as here, it can be sculpted with great detail.



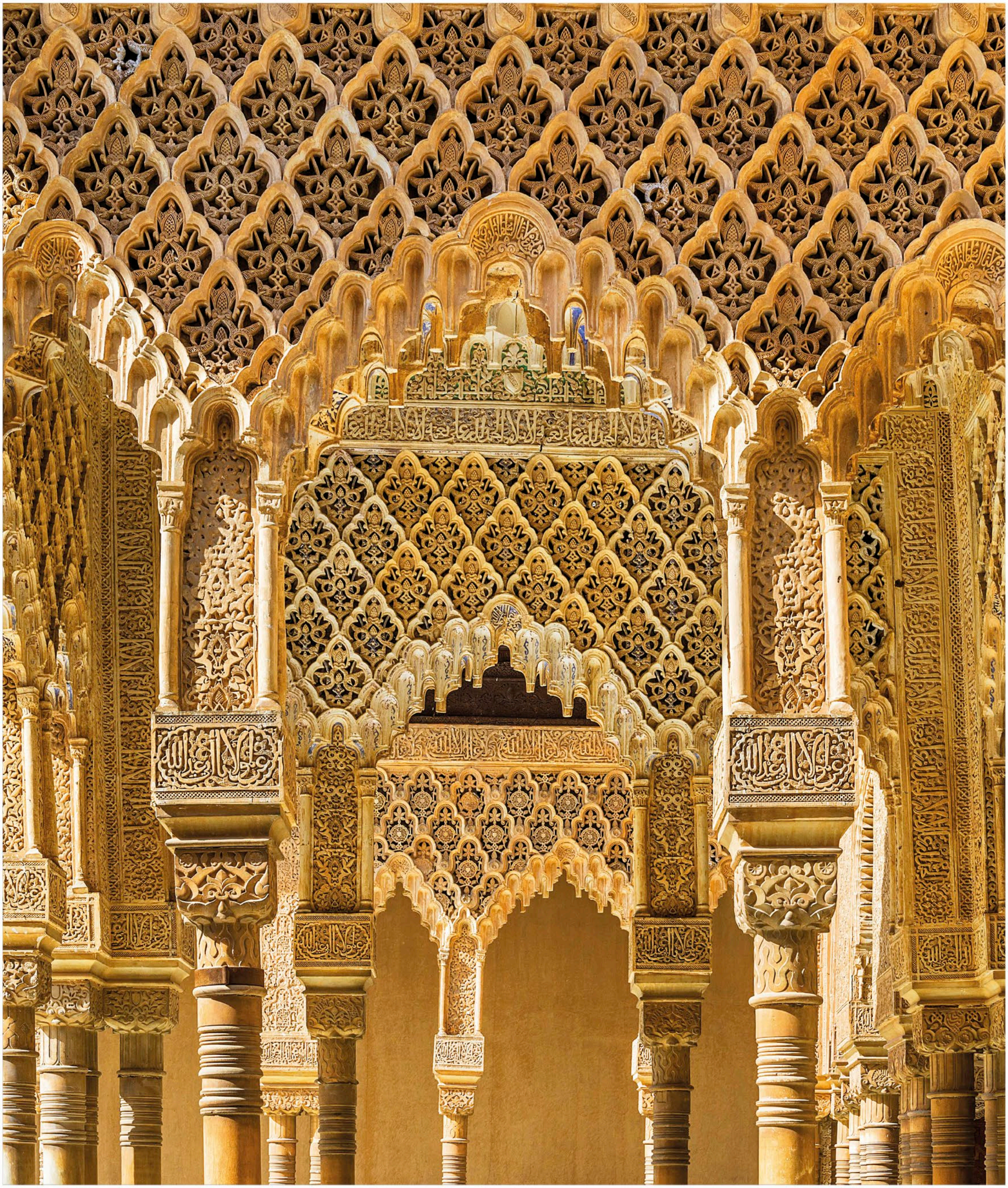
Petra

The Rose City

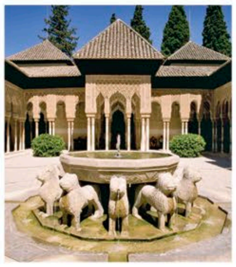
Petra is a famous archaeological site carved into pink sandstone cliffs in the southwest of Jordan, nicknamed the "Rose City" after the rich rose colour of the sandstone. Its intricately carved tombs and temples date back to 300 BCE, when Petra was capital of the Nabatean kingdom. The most famous temple is Al Khazneh, or "the Treasury", a building with an ornate façade, which is accessed via a narrow gorge more than 1km (½ mile) long and flanked on either side by 80m- (250ft-) high cliffs.



Rose-coloured columns The façade of this tomb, with its ornate columns, is carved into sandstone.



Interior of the Palace of the Lions | 14th century | Sandstone, stucco, wood | Found in the Palatial City, the Alhambra, Granada, Spain



Spanish **Alhambra**

△ **Courtyard** of the Lions

The Alhambra in Granada, Spain, is recognizable from afar for its distinctive brickwork made from red clay and gravel: its name means "red castle". The interior is a marvel of stonework and decoration in sandstone, stucco, and wood. Sandstone has long been an important building material. Its durability as both a building and a sculptural material is unsurpassed among sedimentary rocks. Stucco is a fine plaster used to coat walls and moulded into decoration. Used together in the Alhambra, they suffuse the interior with a warm glow and a wealth of textural detail.

In its heyday, the Alhambra was a citadel and palace, but it has since been used as a barracks, prison, and Roma settlement, with farm animals roaming the ruined halls. The Romantics rediscovered it in the 19th century, inspired by its former glories. One famous visitor was Washington Irving, author of *Rip Van Winkle*. Irving invented a history for the citadel's Hall of the Two Sisters, involving a pair of Muslim princesses who fell in love with their Christian captives. One eloped with her suitor, while the other remained behind, a forlorn spinster. The reality is more prosaic – the "sisters" are two large marble flagstones on the floor. This hall was part of the residential quarters, where the *Sultana* (ruler) lived with her children. Its outstanding feature is the muqarnas dome in the centre. Muqarnas is an intricate form of tiered vaulting, made of painted stucco. Based on a geometric design, it has thousands of overlapping, stalactite-like "cells" – possibly a visual reference to the cave in which Muhammed received the revelation of the Koran.

Engraving showing the Alhambra, 1890

Ceiling of the Hall of the Two Sisters: this worm's-eye view of the interior of its muqarnas dome shows its cell-like patterning in stucco

It **absolutely appears** to me like a **dream**

Washington **Irving**
Author

Key dates

889 CE–1984

800

889 CE Sawwar ben Hamdun builds a fortress on the site of the Alhambra

1300

1333 Sultan Yusuf I begins converting the fort into a royal palace

1353–91 During the reign of Mohammed V of Grenada, the Hall of the Two Sisters is constructed, within the Palace of the Lions

1400

1492 After expelling the Moors from Granada, Catholic monarchs Ferdinand and Isabella establish their court here

1500

1526 Charles V of Spain builds a Renaissance-style palace within the Alhambra

Ferdinand and Isabella

1600

c.1600s–1700s The building falls into disrepair and is occupied by squatters

1800

1808–12 Napoleon's troops occupy the Alhambra, using it as a military barracks

1870 The Alhambra is declared a national monument

1900

1984 UNESCO recognises the Alhambra as a World Heritage Site

2000

Marble

△ **Breccia marble**, shattered and re-cemented

A granular rock derived from limestone or dolomite, marble consists of a mass of interlocking calcite or dolomite grains. Pure marble is white. Other types take their common names from their colour or mineral impurities. These impurities tend to occur as layers of other minerals thinly interbedded in the original limestone, so may be present as bands or swirls. Other veined and patterned marbles are created when an existing example is cracked or shattered, and the spaces between the fragments fill in with calcite or other minerals.

Specification

Rock type Regional or contact metamorphic | **Temperature** High | **Pressure** Low to high | **Structure** Crystalline | **Major minerals** Calcite | **Minor minerals** Diopside, tremolite, actinolite | **Colour** White, pink | **Texture** Fine to coarse | **Protolith** Limestone, dolomite

Marble specimen | **Rough** | This specimen consists of minerals – hyalophane crystal and pyrite – enclosed within dolomitic marble.

Marble sphere | **Carved** | This patterned sphere has been polished to a fine finish, highlighting its "tiger stripe" appearance caused by inclusions.

Marble sculpture | **Carved** | The flowing lines of this sculpture cut from marble are emphasized by the simplicity of the carving. It has fine white colouring.

Marble statue | **Carved** | This early 19th-century Italian, large-scale, translucent marble statue depicts wrestlers raised on a rock-shaped base. Fine craftsmanship and a smoothly rendered finish emphasize the translucence of the material. The piece was inspired by an ancient Roman bronze.

Granite

△ **Classic pink granite** containing quartz, feldspar, and mica

Familiar as a mottled pink, white, grey, and black ornamental stone, granite is the most common intrusive rock in the Earth's continental crust. Granite's three main minerals are feldspar, quartz, and muscovite, or biotite mica. Of the three principal minerals, feldspar predominates, and quartz (see pp.132–39) usually accounts for more than 10 per cent. Granite has been a favourite stone for carving and building for at least four millennia. Wherever it has been available, its strength and durability have made it a first choice for everything from temples to millstones.

Specification

Rock type Felsic, plutonic, igneous | **Major minerals** Potassium feldspar, quartz, mica, sodium | **Minor minerals** Sodium plagioclase, hornblende | **Colour** White, light grey, grey, pink, red | **Texture** Medium to coarse

Granite host | **Rough** | Granites are often host to a variety of gemstones – this granite groundmass is covered in tourmaline crystals.

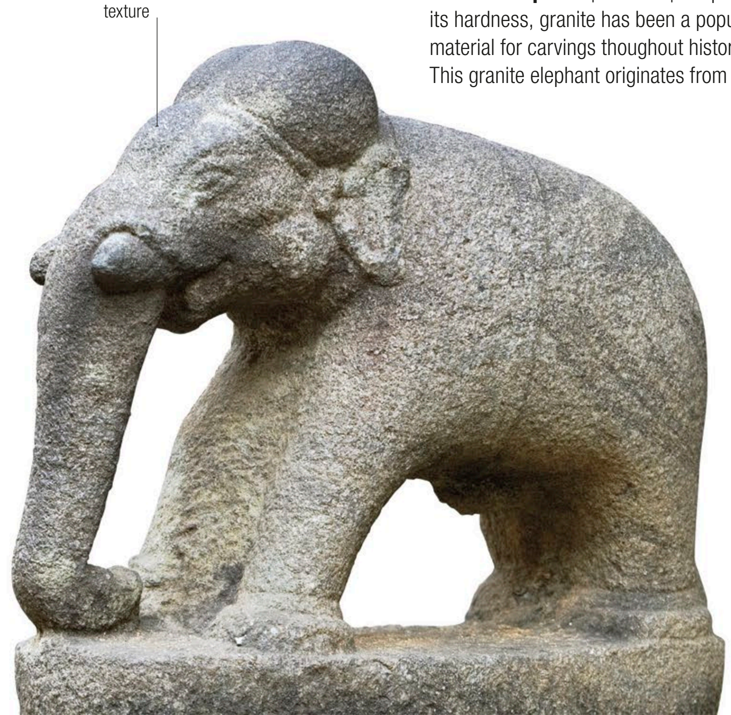
Granodiorite | **Rough** | Commercial "granites" come in a range of colours and textures, depending on their exact makeup. This specimen tends toward granodiorite.

Boulder with microcline | **Rough** | This granite boulder takes its pink colour from the large amount of microcline feldspar that comprises its makeup.

Commercial granite | **Cut** | This sample of kitchen worktop material is commercially sold as "white granite", but is closer to granodiorite in makeup.

Granite bead | **Carved** | The patterns of granite fascinated ancient civilizations, which created carvings such as this bead. The black portion is hornblende.

"Black granite" | **Cut** | This sample of kitchen worktop material is commercially sold as "black granite", although in reality its composition is closer to diorite.



Ancient elephant | **Carved** | Despite its hardness, granite has been a popular material for carvings thoughout history. This granite elephant originates from India.

David by Michelangelo (detail of hand showing exaggerated proportion) | 1501–04 | 5.16m (16ft 11in) high, 5,660kg (12,478lb) in weight | Solid Carrara marble

Michelangelo's David

△ **Michelangelo** (1475–1564), after a self-portrait

One of the masterpieces of the Renaissance or, arguably, of any era, Michelangelo's *David* is exceptional for its lifelike rendering of the male anatomy, vast scale, and unusual treatment of its subject matter. The sculpture represents the biblical David, Israelite slayer of the Philistine giant Goliath. David is carved from solid marble and stands at over 5m (16ft), weighing more than 5 tonnes (5.5 tons). He holds a sling in one hand and a stone in the other. Michelangelo's sculpture is unprecedented in that Goliath is absent and, rather than representing David's victory, shows him poised in the moments before battle. Michelangelo's great achievement is capturing David's pre-battle tension in the protruding veins of his hands, the tautness of his neck, and the focus in his gaze – all at monumental scale. Contemporaries were amazed, even though one, Piero Soderini, declared the nose too wide – prompting Michelangelo to make a pretence of altering it, complete with marble dust.

The statue was intended for the battlements of Florence Cathedral, which may account for the unusually large head and hands, to allow for perspective from below. However, a committee of Florentines, including Leonardo da Vinci and Botticelli, considered the work too exquisite (and heavy) to be displayed there, so it was placed outside the Palazzo della Signoria, the town hall. The position had political significance as the figure of David gazed towards Rome – he was intended to represent Florence, which had recently thrown off the Medici family's rule.

David with Goliath's Head, circle of Caravaggio, c.1600, typically presenting the moment of victory

Sculpture of David as it is today, in Florence

> **Anyone who has seen Michelangelo's David has no need to see anything else by another sculptor, living or dead**
>
> Giorgio **Vasari**
> Painter and artists' biographer, 1511–1574

Key dates

1400–2014

1400

1400 Authorities plan 12 large Old Testament sculptures for the cathedral buttresses

1464 Agostino di Duccio is commissioned to create a sculpture of David, and a huge block of marble is provided

1466 Agostino ceases work for unknown reasons, having started to shape legs, feet, and torso

1476 Antonio Rossellino resumes work on the block, but is released from his contract soon after

1500

1500 Authorities determine to find a sculptor to finish the statue

August, 1501 Michelangelo, aged just 26, wins the contract

September, 1501 Michelangelo begins work on the sculpture

January, 1504 Committee of Florentines decide not to place completed *David* on the cathedral buttresses

June, 1504 *David* is moved to the public square of Palazzo della Signoria (Palazzo Vecchio)

Statue protected by bricks during World War II

1800

1873 *David* is moved to Florence's Galleria dell' Accademia to protect it

1900

1910 A replica is placed on the old site

1939–45 The statue is enclosed in bricks to protect it from bombings

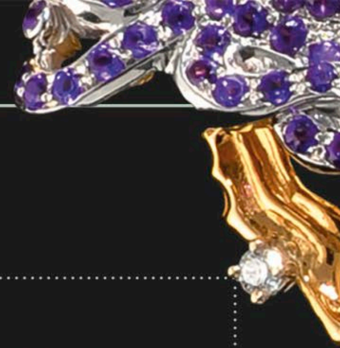
1991 A man damages the toes of the statue's left foot in an attack with a hammer

2000

2010 The Italian Culture Ministry claims ownership of *David*, which the city of Florence disputes

2010

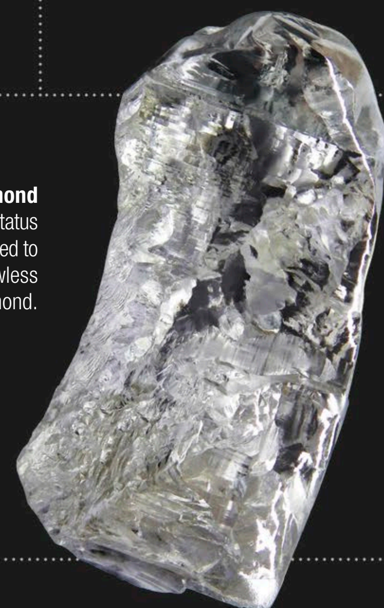
2014 Concerns arise over micro-fractures in the stump supporting the statue, as well as in the legs



Record-breakers

Big, beautiful, and near-perfect – these are the qualities that characterize most of the world's record-breaking gems. Some are kept in the vaults of royal collections or distinguished museums, while others are recent finds fresh from the Earth. Here is a selection of the gems that have set new records for size or quality, both new discoveries and established treasures.

De Beers diamond
This yellow diamond formed the centrepiece of the Patiala Necklace (see pp.90–91).

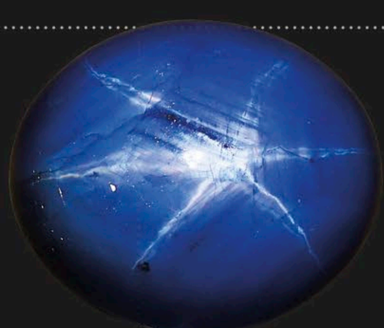


Lucapa diamond
The rare Type IIa status was awarded to this almost flawless rough diamond.

Sweet Josephine
When it sold for $28.5 million in 2015, the 16.08-carat, cushion-cut Sweet Josephine gemstone set a record-breaking price for pink diamonds.

Gachala emerald
One of the largest uncut emeralds in the world, the Gachala weighs 858 carats.

Carmen Lucia ruby
This 23.1-carat Burmese ruby has uniquely fine colour and clarity.



Star of Adam
This gem, the world's largest blue star sapphire, was found in 2015 in Ratnapura, Sri Lanka.

Olympic Australis opal
At 99 per cent pure gem-quality opal, the Olympic Australis is the most valuable opal in the world.

Paraiba Star of the Ocean
This is the world's largest Paraiba tourmaline, set by Kaufmann de Suisse in 2013.

Blue Giant of the Orient
Found in 1907, this gem still holds the record as the largest sapphire in the world.

Alexandrite
Notable for its quality, this alexandrite stone from the Smithsonian's collection weighs 17.08 carats.

Strawn-Wagner diamond
The only perfect diamond ever found, the Strawn-Wagner has an AGS grade of 0/0/0.

MODERN BRANDS

The influence of marketing and advertising from the mid-19th century onwards transformed the way consumers perceived jewellery. It was no longer simply an asset with a value based on gem quality, metal content, and rarity: the value now came from its brand association, too. Jewellery was presented to the consumer as a symbol of a particular lifestyle that extended beyond rings and watches to encompass fragrance and homewares, culture and the arts, exclusive sporting events, and celebrities on the red carpet.

Tiffany & Co. took the lead in the USA in 1845, publishing its Blue Book jewellery catalogue, which was one of the first of its kind. Refining the colour theme, in 1878 it introduced its signature blue colour to packaging and advertising, which became integral to the brand's image. Cartier, meanwhile, used its links with European royalty to create an identity of prestige and refined taste. It launched a line of lifestyle products, Les Must de Cartier, and sponsored events such as polo to cement its image of exclusivity. Other brands, from upscale Van Cleef & Arpels to mass-market Pandora, have since projected their identities to the public in a similar way.

I've **never** thought of my **jewellery as trophies...** we are only **temporary custodians** of beauty

Elizabeth **Taylor**
Actress

Panthère de Cartier watch Playful and powerful, and representing elegance, power, and luxury, the big cat has been incorporated in many of Cartier's luxury watches, such as this lavish example, and other decorative jewellery pieces in its Panther collection.

5

Colour guide

Colour guide

This directory loosely groups minerals according to their primary colour. Where multiple colours are available, these are listed in the text.

Diamond | **See pp.52–57** | Diamond can be colourless, white to black, yellow, pink, red, blue, or brown. It is transparent to opaque with an adamantine lustre.

Quartz (Namibian) | **See pp.132–39** | Colourless, yellow, pink, or green, this variety of quartz is transparent to opaque, with a vitreous lustre.

Quartz (rutilated) | **See pp.132–39** | Rutilated quartz is colourless with gold, red, or green needles of rutile. It has a vitreous lustre and is transparent.

(Quartz) rock crystal | **See pp.132–39** | Naturally occurring in a colourless form only, rock crystal has a vitreous lustre. It is transparent.

Selenite | **See p.123** | Selenite can be colourless, white, yellow, or light brown. It is transparent to translucent, with a vitreous or pearly lustre.

Pollucite | **See p.185** | Pollucite may be colourless or grey, blue, or violet. It ranges from transparent to opaque, and has a vitreous lustre.

Danburite | **See p.246** | Ranging from colourless to yellow, brown, or pink, danburite is transparent with a vitreous lustre.

Celestine | **See p.121** | Celestine occurs as colourless, white, red, green, blue, or brown. It is transparent to translucent with a vitreous lustre.

Amblygonite | **See p.117** | Amblygonite is colourless, white, yellow, pink, brown, green, or blue. It is transparent with a vitreous or pearly lustre.

Phenakite | **See p.282** | Phenakite is colourless, yellowish, pink, or greenish blue, and is either transparent or translucent with a vitreous lustre.

Tourmaline (achroite) | **See pp.226–29** | Achroite, a variety of tourmaline, is colourless with a vitreous lustre. It is transparent to translucent or opaque.

Albite | **See p.172** | Albite may be colourless, greenish, bluish, or black. With a vitreous or pearly lustre, it ranges from transparent to opaque.

Euclase | **See p.283** | With colourless, white, blue, or green varieties, euclase is transparent to translucent and has a vitreous lustre.

Platinum | **See pp.44–45** | This precious metal is silver-white in colour. Platinum has a metallic lustre and is opaque.

Silver | **See pp.42–43** | This popular precious metal is silver-white, tarnishing to black. It has a metallic lustre and is opaque.

Pyrite | **See p.66** | This gem naturally occurs with a silver or pale brass-yellow colouring. Pyrite has a metallic lustre and is opaque.

Pearl | **See pp.292–95** | White, cream, black, blue, yellow, green, or pink varieties of pearl may be found. It is opaque with a pearly lustre.

Marble | **See p.328** | This opaque stone is found in a wide range of colours, with violet, red, blue, or white veins. It can be dull, pearly, or subvitreous.

Howlite | **See p.127** | Occurring as off-white, often with a grey or black “spiderweb” matrix, howlite is opaque with a vitreous or dull lustre.

Petalite | **See p.197** | Ranging from colourless to pink or yellowish in colour, petalite has a pearly lustre and is transparent.

Quartz (aventurine) | **See p.134** | This quartz may be grey, green, red-brown, or gold-brown. It is translucent or opaque with a vitreous or waxy lustre.

Quartz (chatoyant) | **See p.137** | Greyish in colour, with a weak cat’s-eye effect, the chatoyant quartz is translucent with a greasy lustre.

Bytownite | **See p.173** | Yellowish or reddish brown, bytownite is either transparent or translucent and may have a vitreous or dull lustre.

Quartz (smoky) | **See p.137** | Smoky quartz is clear brown, varying from a light brown to dark brown. It has a vitreous lustre and is transparent to opaque.

Chrysoberyl (Alexandrite) | **See pp.84–85** | Alexandrite can be transparent or translucent with a vitreous lustre. In gem form, it is pleochraic.

Jet | **See pp.306–307** | Jet ranges from dark brown to deep black. It has an opaque appearance with a lustre that may be waxy or dull.

Garnet (melanite) | **See pp.258–63** | A deep black in colour, this variety of garnet has a vitreous or subadamantine lustre. It is translucent or opaque.

Onyx | **See pp.154–55** | Black onyx is black with white layers, which may appear as straight colour bands. It has a waxy lustre and is opaque.

Tourmaline (schorl) | **See pp.226–29** | Schorl is black, blue-black, or brown-black. It may be translucent or opaque, with a vitreous or resinous lustre.

Obsidian | **See p.323** | Translucent with a vitreous lustre, obsidian ranges from black, bluish, and mahogany, to golden or peacock, among other hues.

Anthracite | **See p.309** | Anthracite is opaque, ranging from black to steel grey in colour, and shines with a submetallic lustre.

Peanut wood | **See p.318** | This opaque fossilized wood is dark brown to black, with white to cream peanut-sized, ovoid shapes. It is vitreous or greasy.

Enstatite | **See p.202** | Found in brown, grey, white, green, or yellow, enstatite may appear translucent or opaque. It has a vitreous lustre and a grey streak.

Epidote | **See p.251** | Epidote is found as brown, pistachio green, yellow, or greenish black. Vitreous to resinous in lustre, it can be transparent to nearly opaque.

Axinite | **See p.247** | Found as brown, yellowish-green, green, bluish-green, or blue material, axinite is transparent with a vitreous lustre.

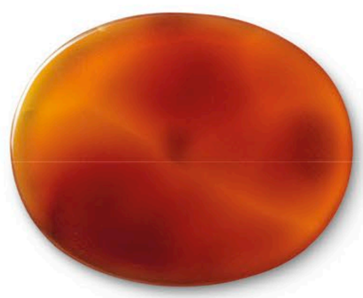
Bronzite | **See p.205** | With a brown or greenish hue, bronzite may be transparent, translucent, or opaque, and has a submetallic lustre.

Hypersthene | **See p.204** | With dark hues of black to black-brown or black-green, this gem is vitreous or silky in lustre and transparent to opaque.

Copper | **See pp.48–49** | This metal is brown to copper red, tarnishing to black or green. It has an opaque appearance and a metallic lustre.

Agate | **See pp.152–53** | Red, yellow, green, reddish brown, white or bluish white, with varied banding, agate is waxy in lustre and translucent to opaque.

Rutile | **See p.94** | With an adamantine to submetallic lustre, rutile is brown, red, pale yellow, pale blue, violet, or black, ranging from transparent to opaque.



Chalcedony (sard) | **See pp.146–47** | This gem is a brownish red (sard) and is translucent through to opaque, with a waxy lustre.

Chalcedony (carnelian) | **See pp.146–47** | This variety of chalcedony is brownish red to orange, and translucent or opaque, with a waxy or resinous lustre.

Fire opal | **See pp.158–59** | This red, orange, or yellow variety of opal has a vitreous lustre and runs from transparent to translucent to opaque.

Chalcedony (jasper) | **See pp.146–49** | Jasper occurs in all colours, most commonly in reddish hues, with most examples striped or spotted. With a vitreous lustre, it is opaque.

Calcite | **See p.98** | From transparent to opaque, calcite can be orange, white, yellowish, pink, bluish, or colourless. It has a vitreous or resinous lustre.

Aragonite | **See p.99** | Commonly banded, this gem is reddish, yellowish, white, greenish, bluish, or violet. Transparent to opaque, it has a vitreous lustre.

Onyx (sardonyx) | **See pp.154–55** | This stone is brownish red with white or black parallel stripes. It is translucent with a vitreous, silky lustre.

Amber | **See pp.310–11** | Occurring in yellow, white, red, green, blue, brown, or black form, amber is transparent to opaque with a lustre that is resinous.

Tourmaline (dravite) | **See pp.226–29** | Dravite is dark yellow, yellow brown, or brownish black. It has vitreous lustre and is transparent to opaque.

Cassiterite | **See p.88** | Commonly found in brown or black tones with colour bands, cassiterite has an adamantine lustre and is transparent to opaque.

Quartz (citrine) | **See p.137** | This quartz variety is light yellow to dark yellow or gold-brown. It is transparent to translucent with a vitreous lustre.

Baryte | **See p.120** | Yellow, colourless, white, brown, gray, black, or with red, blue or green tints, it is transparent to opaque, with a vitreous lustre.

Copal | **See p.308** | In shades of yellow, white, red, green, blue, brown, or black, copal is transparent to opaque with a resinous lustre.

Scheelite | **See p.126** | Scheelite can be yellow, yellowish white, colourless gray, orange, or brown. It is transparent, with an adamantine lustre.

Scapolite | **See p.184** | Scapolite occurs as yellow, rose-pink, violet, or colourless material. It is transparent and has a vitreous lustre.

Gold | **See pp.36–39** | Displaying a distinctive rich yellow colour, paling to a whitish-yellow, gold is opaque and has a metallic lustre.

Garnet (topazolite) | **See pp.258–59** | Yellow to yellow-brown, topazolite ranges from transparent to translucent with a subadamantine or vitreous lustre.

Andalusite | **See p.274** | Andalusite may be yellowish green to green, brown, pink, or colourless, with a vitreous lustre. It runs from transparent to opaque.

Titanite | **See p.275** | Titanite may be yellow, green, or brown, or mixtures of these. From transparent to opaque this gem has an adamantine lustre.

Beryl (Heliodor/golden beryl) | **See pp.240–41** | Heliodor is lemon to golden yellow, with a greenish tinge. It is transparent to opaque, with a vitreous lustre.

Brazilianite | **See p.116** | With green, yellowish-green or golden hues and a vitreous lustre, brazilianite has a transparent appearance.

Apatite | **See p.118** | Apatite is transparent and is found in a range of colours, from yellow, green, and colourless, to blue and violet. It has a vitreous lustre.

Tourmaline (elbaite) | **See pp.228–29** | This is green, yellow, red, orange, colourless or blue, transparent or translucent, and has a vitreous or resinous lustre.

Chrysoberyl | **See pp.84–85** | Of vitreous lustre, this gem can be shades of green, gold, yellow, red, or brown. It is transparent to opaque.

Garnet (andradite) | **See pp.258–63** | From transparent to translucent, andradite is green, yellow, black, or colourless with a subadamantine or vitreous lustre.

Prehnite | **See p.198** | Prehnite occurs in a greenish or oily yellowish colour, and has a translucent appearance with a lustre that is vitreous or pearly.

Serpentine | **See p.190** | Green, yellowish-green, white, yellow-brown, red-brown or black, serpentine's lustre is greasy. It is translucent to opaque.

Moonstone | **See pp.164–65** | Green, colourless, white, adularescent (with a milky or blue glow), brown, or red, it is transparent or translucent and vitreous.

Jade | **See pp.212–13** | Green is most prized, but jade also occurs in other colours. It is vitreous in lustre and translucent through to opaque.

Chalcedony (chrysoprase) | **See pp.146–149** | Chrysoprase is green or yellowish green, with translucent to opaque examples and a resinous lustre.

Fluorite | **See pp.96–97** | Transparent to opaque, fluorite is green, colourless, yellow, pink, red, brown, blue, or violet with a vitreous lustre.

Variscite | **See p.104** | Variscite ranges from green and yellow-green to green-blue. It is either translucent or opaque and has a waxy lustre.

Diopside | **See p.203** | With shades of green, yellow, colourless, brown, or black, diopside is transparent to opaque with a vitreous lustre.

Peridot | **See pp.254–55** | Green, yellow-green, or brown-green in colour, peridot has a vitreous, greasy lustre and a transparent appearance.

Hiddenite | **See p.208** | Of vitreous lustre, this gem occurs in shades of emerald-green, yellow-green, and green-yellow. It is transparent.

Common opal | **See pp.158–61** | The common opal offers a wide variety of colours, but green is most common. It has a waxy to resinous lustre and is translucent to opaque.

Serpentine | **See p.190** | Green, yellowish-green, white, yellow-brown, red-brown, or black, serpentine's lustre is greasy. It is translucent to opaque.

Malachite | **See p.107** | A deep, saturated green with banding, malachite's lustre may range from vitreous to silky to dull. It is opaque in appearance.

Garnet (demantoid) | **See pp.258–63** | This green to yellowish green variety of garnet is transparent. It also has an adamantine lustre.

Tourmaline (watermelon) | **See pp.226–29** | Watermelon tourmaline's name derives from its green rims on red or pink cores. It is transparent with a vitreous lustre.

Vesuvianite | **See p.247** | A green, yellowish-green, yellowish brown, or violet gem, vesuvianite is transparent to translucent with a greasy lustre.

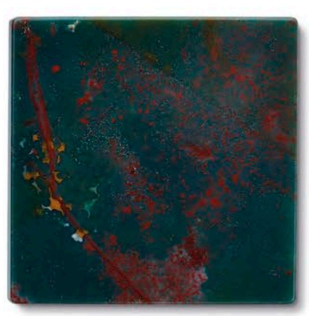
Chrysoberyl (cat's eye) | **See p.84–85** | With a chatoyant effect, this greenish yellow to yellow-brown gem is opaque with a vitreous to resinous lustre.

Moldavite | **See p.322** | This gem has a bottle-green to brown-green colour. It is translucent to opaque and has a vitreous lustre.

Kornerupine | **See p.252** | This transparent gem with a vitreous lustre can range from green to blue-green and mixtures of brown and green.

Ammolite | **See p.319** | With a play of mostly green or red colour in a mosaic-like pattern, ammolite has greasy lustre and appears opaque.

Precious opal | **See pp.158–61** | Precious opal exhibits a play of colours that includes all shades. With a vitreous lustre, it is transparent to opaque.



Chalcedony (bloodstone/heliotrope) | **See pp.146–51** | With blood-like spots on dark green, bloodstone chalcedony is translucent to opaque with a waxy, resinous lustre.

Tourmaline (indicolite) | **See pp.226–29** | Indicolite is a dark blue to blue variety of tourmaline. It is transparent to opaque and has a vitreous lustre.

Chrysocolla | **See p.196** | Green to blue, and exhibiting veins and patches, chrysocolla has a vitreous, waxy lustre, and is opaque.

Dioptase | **See p.220** | With a vitreous lustre, dioptase is translucent and coloured a vivid, but dark, emerald green or bluish green.

Emerald | **See pp.232–33** | Emerald ranges from emerald green to a slightly yellowish green. Vitreous in lustre, it is transparent to opaque.

Microcline | **See p.171** | Microline can be blue to green, but is usually white to pale yellow or salmon. It has a vitreous lustre and is translucent to opaque.

Smithsonite | **See p.105** | Of vitreous or pearly lustre, smithsonite may be blue, white, yellow, orange, brown, green, gray, or pink. It is translucent to opaque.

Turquoise | **See p.110–11** | Light blue to greenish blue, turquoise may have "spiderweb" inclusions. With a waxy or dull lustre, it is translucent to opaque.

Tourmaline (paraiba) | **See p. 226–29** | Paraiba is found in mint green to sky blue, sapphire blue, and violet to purple. It is transparent and vitreous.

Beryl (goshenite) | **See p.236–41** | Goshenite is a colourless variety of beryl. Of vitreous lustre, it ranges from transparent to translucent.

Chalcedony | **See pp.146–49** | Found in all colours, chalcedony, a variety of quartz, is waxy in lustre, ranging from translucent and opaque.

Quartz (milky) | **See p.136** | This cloudy white quartz variety has semi-transparent, translucent and opaque examples and shows a greasy lustre.

Phosphophyllite | **See p.199** | Occurring in blue-green to colourless forms, phosphophyllite is translucent with a vitreous lustre.

Pectolite | **See p.217** | This gem of silky lustre may be found as light blue, light green, colourless, or gray. It can be transparent or translucent.

Lazulite | **See p.119** | Lazulite is blue-white to dark blue or green-blue with a vitreous lustre. It can be transparent, translucent, or opaque.

Topaz | **See pp.272–73** | Topaz may be blue, colourless, yellow, brownish, green, pink, red, or violet. Its lustre is vitreous and it is transparent.

Beryl (aquamarine) | **See pp.236–41** | This blue or greenish blue variety of beryl has a vitreous to resinous lustre, and is transparent to translucent.

Kyanite | **See p.280** | Kyanite has a vitreous, pearly lustre and is blue, green, brown, yellow, red, or colourless. It ranges from transparent to translucent.

Zircon | **See p. 268–69** | Blue, green, yellow, brown, red or colourless, zircon may be transparent to translucent. The mineral also has a vitreous lustre.

Tourmaline (indicolite) | **See pp.228–29** | Indicolite is a blue to dark blue variety of tourmaline. It is transparent to opaque and has a vitreous lustre.

Azurite | **See p.106** | Azurite is azure blue or dark blue. It can be transparent, translucent, or opaque, and has a vitreous lustre.

Benitoite | **See p.223** | Benitoite is blue, purple, pink, or colourless. Transparent or translucent, its lustre is vitreous, subadamantine, or adamantine.

Iolite (or courdierite) | **See p.222** | Mostly occurring in a violet-blue colour, Iolite has a vitreous, greasy lustre and may appear as either transparent or translucent.

Hauyne | **See p.181** | Hauyne is azure blue, green-blue, or a blue-white. Its lustre is vitreous and it occurs in transparent, translucent, or opaque form.

Sapphire | **See pp.70–73** | Sapphire occurs in various blues, as well as most other colours. Lustre is subadamantine, vitreous, or pearly. It is transparent to opaque.

Kyanite | **See p.280** | Kyanite has a vitreous, pearly lustre and is blue, green, brown, yellow, red, or colourless. It ranges from transparent to translucent.

Tanzanite | **See p.253** | Tanzanite occurs in shades of sapphire blue, amethyst, or violet. It is transparent and has a vitreous lustre.

Lapis lazuli | **See pp.174–177** | This gem is intense deep blue, violet, or greenish blue and may contain gold-coloured pyrite flecks. It has a vitreous, greasy lustre and is opaque.

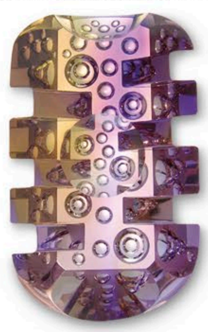
Labradorite | **See p.169** | Dark or black-gray, and labradorescent (golden yellow, blue-green, purple, bronze), this gem is vitreous and transparent to opaque.

Hematite | **See p.86** | Hematite may be found as black, steel gray, or partially reddish in colour. It has a metallic lustre and is opaque.

Dumortierite | **See p.277** | Dumortierite is dark blue, violet-blue, red-brown, or colourless, ranging from translucent to opaque. It is vitreous in lustre.

Sodalite | **See p.180** | Sodalite appears as blue or blue-violet with a lustre that is vitreous or greasy. It is transparent, translucent, or opaque.

Quartz (amethyst) | **See p.136** | Amethyst is a purple, violet, or pale red-violet quartz. It has a vitreous lustre and is transparent to opaque.



Quartz (ametrine) | **See p.138** | This variety of amethyst is purple or violet. Like amethyst, it has a vitreous lustre and is transparent to opaque.

Sugilite | **See p.221** | Either violet or purple-red in colour, sugilite has a resinous lustre and is transparent, translucent, or opaque.

Thulite | **See p.253** | This pink to red variety of zoisite is often mottled with white and grey. It has a vitreous lustre and an opaque appearance.

Fluorite (blue John) | **See pp.96–97** | This gem is a banded purple and white with a vitreous lustre. It ranges from transparent to translucent.

Beryl (red) | **See pp.236–41** | A red to violet-red variety of beryl, this mineral may be transparent to translucent. It has a vitreous lustre.

Tourmaline (rubellite) | **See pp.226–29** | Rubellite is a strong dark red to a pinkish red. With a vitreous lustre, it is transparent to opaque.

Garnet (almandine) | **See pp.258–63** | Almandine is a red to violet-red variety of garnet. It is transparent and has a vitreous lustre.

Ruby | **See pp.76–77** | Occuring in red, deep crimson, and pink shades, ruby has a pearly, subadamantine, or vitreous lustre and is transparent to opaque.

Spinel | **See pp.80–81** | Found in red, pink, orange, blue, violet, or blue-green, spinel is transparent and has a lustre that is vitreous.

Cuprite | **See p.89** | Cuprite is carmine red or dark grey in colour, has a transparency that is translucent, and shines with a metallic lustre.

Sphalerite | **See p.67** | Red-yellow, yellow, green, brown, or black, sphalerite is adamantine and greasy in lustre, and transparent to opaque.

Garnet (almandine) | **See pp.258–63** | Almandine is a red to violet-red variety of garnet. It is transparent and has a vitreous lustre.

Rhodochrosite | **See p.100** | Rhodochrosite is pinkish to red in colour and can have a vitreous or resinous lustre. It has a transparent appearance.

Coral | **See pp.314–15** | Coral occurs as red, pink, white, orange, blue, or brown. It it ranges from translucent to opaque and has a vitreous lustre.

Rhodonite | **See p.216** | Red, grey-red, or orange-red, rhodonite's lustre is vitreous to dull and it can be transparent, translucent, or opaque.

Sunstone | **See p.168** | Sunstone is found in hues of red and brown, or golden brown. It is aventurescent (with metallic glitter), translucent to opaque, and vitreous.

Orthoclase | **See p.170** | Occurring as yellow or colourless, orthoclase has a vitreous or pearly lustre, and a transparent appearance.

Diaspore | **See p.93** | Pink, greenish-brown, colourless, white, yellow, or bluish, diaspore has a vitreous or pearly lustre and is transparent to translucent.

Zoisite | **See p.253** | Zoisite is red-violet, green, brown, or bluish green with a vitreous lustre. It can be transparent, translucent, or opaque.

Pezzottaite | **See p.192** | Pezzottaite is rose-red to pink with a vitreous lustre. It ranges from transparent to translucent.

Quartz (rose) | **See p.136** | Appearing in a range of strong to pale pink colours, rose quartz has a vitreous lustre and is translucent.

Taaffeite | **See p.87** | Taaffeite may be pink, violet, colourless, pale green, bluish, or red. It has a vitreous lustre and is transparent.

Beryl (morganite) | **See pp.236–41** | Morganite is soft pink to violet or salmon, and transparent with a vitreous lustre.

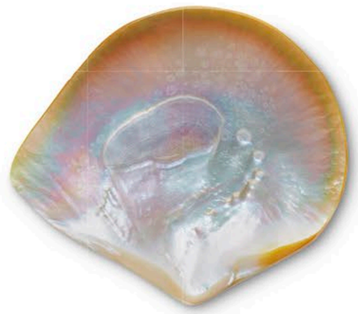
Kunzite | **See p.209** | Kunzite may be found in pink to violet-pink hues, with a vitreous lustre. The mineral has a transparent appearance.

Sillimanite | **See p.276** | Occurring in shades of blue and green, grey-green, brownish or colourless, it has a vitreous lustre and is transparent to opaque.

Cerussite | **See p.101** | With an adamantine lustre, cerussite is yellow, brownish, colourless, white, blue-green, grey, or black. It is transparent to opaque.

Granite | **See p.329** | Granite ranges from pink to a white or grey colour and has a dull lustre. It has an opaque appearance.

Seashell | **See p.298** | White, grey, silver, yellow, blue-green, pink, red, brown, bronze, or black, seashell has a pearly lustre and is translucent to opaque.



Mother of pearl | **See p.299** | Found in most colours, as well as iridescent purples, blues, and greens, mother of pearl has a pearly lustre and is translucent to opaque.

Limestone | **See p.324** | Limestone is commonly white, but also brown, yellow, red, blue, black, or grey. It has a dull lustre and is opaque.

Alabaster | **See p.122** | Alabaster has a white appearance with a dull lustre. It may range in transparency from translucent to opaque.

Scapolite | **See p.193** | This transparent gem may be colourless, or range from yellow to rose pink or violet. It has a vitreous lustre.

Staurolite | **See p.281** | Staurolite may have a reddish brown or black appearance with a vitreous lustre. It is translucent and, more rarely, transparent.

Sandstone | **See p.325** | Sandstone can be tan, brown, yellow, red, grey, pink, white, or black. It has a vitreous lustre and is opaque.

Soapstone | **See p.191** | Soapstone is opaque with a greasy lustre, and ranges from greenish to yellowish, white, greenish brown, or reddish.

Colour in minerals is caused by the **absorption or refraction** of light of **particular wavelengths**

6

Glossary and Index

Glossary

A

Acicular
Needle-like; the crystal habit of some minerals.

Adamantine
A bright, diamond-like lustre.

Adularescence
See *Opalescence*.

Allochromatic
Gems coloured by impurities, without which they would be colourless.

Asterism
A four- or six-ray star effect displayed by certain gems, including some sapphires and rubies, that have been cut *en cabochon*; the optical effect is caused by the reflection of light on fibrous or rutile inclusions.

B

Bezel
The part of the mounting that surrounds the girdle of a stone with a metal band.

Birefringence
In doubly refractive gems, this is the difference between the highest and lowest refractive indices.
See also *Double refraction*.

Brilliant cut
A round cut featuring mathematically calculated proportions of triangular facets top and bottom, which are designed to maximize a diamond's fire and brilliance.

C

Cabochon
A polished cut with a domed upper surface and a flat or domed under surface; gems cut in this way are described as being cut *en cabochon*.

Cameo
A low-relief design that has been cut into layered stone or shell, with the background material cut away.

Carat
A unit of gemstone weight. One carat equals 0.2g (0.007oz). (Not to be confused with karat, a measure of gold purity.)
See also *Karat*.

Chatoyancy, chatoyant
The cat's-eye effect shown on certain gems that have been cut *en cabochon*.

Clast
A fragment or grain of rock, usually broken off as a result of physical weathering; clastic rocks are a form of sedimentary rock composed of such clasts.

Cleavage
The way that some minerals break along planes determined by their atomic structure.

Crown
The top part of a cut stone, above the girdle.

Cryptocrystalline
An extremely fine-grained crystalline mineral habit, in which individual crystallized components can only be seen under a microscope.

Crystal
A solid with an ordered internal atomic structure that produces a typical external shape, along with characteristic physical and optical properties.

Crystal structure
The internal atomic structure of a crystal. All crystalline gems may be classified according to the symmetry of their structure: cubic; tetragonal; hexagonal; trigonal; orthorhombic; monoclinic; and triclinic.

Culet
The lowest part of a cut stone, either a point or a ridge.

Cushion
A square cut with rounded sides and corners.

Cut
The shaping of a gemstone by grinding and polishing; the shape of the final gem, as, for example, in brilliant cut.

D

Dendritic
Tree-like; the crystal habit exhibited by some minerals.

Diffraction
The splitting of white light into its constitutent colours – the colours of the rainbow – when it passes through a hole or grating; the bending of light rays around the edge of an obstacle.

Dispersion
The splitting of white light into its constitutent colours – the colours of the rainbow – as it passes through an inclined surface such as those on a prism or a faceted gem. Dispersion in gems is known as fire.

Double refraction (DR)
The splitting of light into two separate rays as it enters a gem. Each ray travels at a different speed and has its own refractive index.

E

Extrusive
A type of rock formed from lava that has either flowed onto the Earth's surface or was ejected from a volcanic vent.

F

Faces
The flat surfaces that make a crystal's external shape.

Facet, faceting
The cutting and polishing of multiple flat surfaces (facets) on a gem. The cut is named according to the number and shape of the facets.

Fancy
A gem cut with an unconventional shape, such as a heart.

Fire
See *Dispersion*.

Fluorescence, fluorescent
The glow of some gems under ultraviolet light, caused by impurities in their crystal structure.

Fracture
A mineral breakage or chipping unconnected to cleavage planes, which is thus often uneven.

Freeform cut
A fancy cut that does not follow a regular geometric pattern.

G

Geode
A rock cavity, often rounded, that is lined with crystals.

Girdle
A band around the widest part of a cut gem, dividing the crown and the pavilion.

Granular
Having grains, or being in the form of grains.

Groundmass
A fine-grained rock in which larger crystals are set or upon which they rest. See also *Matrix.*

H

Habit
The external shape in which a crystal grows because of its molecular structure.

I

Idiochromatic
A self-coloured gem, in which the colour comes from its chemical composition, not from impurities.

Igneous
A type of rock formed from solidified molten rock.

Inclusion
A crystal or fragment of another substance occurring within a gem; it is sometimes a way of identifying a species of gem.

Intaglio
A design in which the subject is cut lower than the background; the reverse of a cameo. See also *Cameo*.

Intrusive
An igneous rock that has solidified within other rocks under the Earth's surface.

Iridescence, iridescent
The rainbow array of colours displayed when light reflects off elements within a gem.

K

Karat
A unit describing the purity of gold. It refers to the amount of gold in 24 parts of a gold alloy. 24-karat is pure gold; 18-karat is three-quarters gold; 12-karat is half gold; and so on. See also *Carat*.

L

Lapidary
A person who cuts and polishes gems.

Lustre
The shine of a gem, which is caused by reflected light.

M

Massive
A mineral that has no definite shape or consists of small crystals in masses.

Matrix
The rock in which a gem is found. Also known as groundmass, host rock, or parent rock.

Metamorphic
A rock that has been transformed from one type of rock into another, due to the effects of heat or pressure, or a combination of the two.

Microcrystalline
A mineral habit in which crystals are too small to be seen with the naked eye.

Mineral
An inorganic, naturally occurring material that has a fixed chemical composition and a regular internal atomic structure.

Mixed cut
A cut in which the facets above and below the girdle differ. This usually takes the form of a brilliant cut above and a step cut below.

Mohs scale
The measure of a gem's relative hardness based on its resistance to scratching.

Mounting
The jewellery piece that a gem is, or gems are, set into. Also called a setting.

N

Native element
A chemical element that occurs naturally uncombined with other elements.

O

Opalescence
A bluish-white form of iridescence.

Ore
A rock or mineral from which a metal can be commercially extracted.

Organic gem
A gem that is composed of material made by, or from, living organisms.

P

Parti-coloured
Single crystals that are made up of different colours.

Pavilion
The lower part of a faceted gem, below the girdle.

Pegmatite
A type of mineral vein that is characterized by the presence of large, often well-formed, crystals.

Phenocryst
A relatively large crystal set into the matrix of an igneous rock, giving it a porphyritic texture.

Placer deposit
A (secondary) deposit of minerals derived by weathering, and concentrated in streams or beaches because of their high specific gravity.

Pleochroic
A gem that exhibits different colours when viewed from different angles.

Polymorph
A substance that can exist in two or more crystalline forms; one crystalline form of such a substance.

Porphyry, porphyritic
An igneous rock that is textured by large crystals set in a finer matrix.

Precipitation
The condensation of a solid from a liquid or gas.

Prismatic
A mineral habit in which parallel rectangular faces form prisms.

Pseudomorph
A crystal with the outward form of another mineral species.

R

Refraction
The bending of light rays as they pass from one medium into another.

Refractive index (RI)
The measure of light slowing down and bending as it enters a gem. It can be used to identify cut gems and some mineral species.

Rhombohedral
A crystal that is shaped like a skewed cube.

Rock
Material made up of one or more minerals.

Rough
An uncut gem crystal.

S

Scalenohedral
A crystal composed of two base-to-base hexagonal pyramids.

Schiller effect, sheen
A brilliant play of bright colours in a crystal that is often due to minute, rod-like inclusions. It is a form of iridescence.

Sedimentary
A rock formed by the consolidation and hardening of fragments of pre-existing rock, organic remains, or other material.

Species
Of gemstones, individual gems that have definite, verifiable characteristics.

Specific gravity (SG)
The ratio of the mass of a mineral to the mass of an equal volume of water. Specific gravity is numerically equivalent to density (mass divided by volume) in grams per cubic centimetre.

Step cut
A type of cut with a rectangular table facet and girdle, with parallel rectangular facets.

Striation
A series of parallel grooves or lines on a crystal.

T

Table facet
The central facet on the crown of a gem.

Tabular
A habit in which crystals take the shape of a thin box.

Tetrahedral
A crystal made up of four triangular faces in pairs, rotated 90 degrees from each other.

Tumble polishing
The process of rotating gemstones in a barrel with abrasives in order to round and polish them.

Twinned crystals
Crystals that grow together as mirror images with a common face or at angles of up to 90 degrees to each other.

V

Variety
Of gemstones, a subspecies that has characteristics which are similar but not distinct enough to justify being classed as a separate species.

Vein
A thin, sheet-like mass of rock that fills fractures in other rocks.

Vitreous
Possessing a glass-like lustre, common in gemstones.

Index

A

B

C

D

E

T

U

V

W

Y

Z

Acknowledgments

The publisher would like to thank the following for their work on this book:
Contributors: Ronald Bonewitz, Iain Zaczek, Alison Sturgeon, Alexandra Black. UK consultant: Andrew Fellows. Indexer: Margaret McCormack. Editorial assistance: Fergus Day, Richard Gilbert, Georgina Palffy, Helen Ridge, Anna Limerick, Kate Taylor, Sam Atkinson, Kathryn Hennessy. Design assistance: Phil Gamble, Saffron Stocker, Phil Fitzgerald, Steve Crozier, Tom Morse, Ray Bryant, Paul Reid at cobalt id, Vanessa Hamilton. DTP Designers: Syed Mohammad Farhan, Vijay Kandwal, Ashok Kumar, Mohammad Rizwan. Additional photography: Gary Ombler, Richard Leeney.

Dorling Kindersley would especially like to thank the following for their assistance:
Robert Acker Holt, Samantha Lloyd, and all at **Holts Gems** for kindly allowing us to photograph their collection; **The Al Thani Collection**; Laura Behaegel and Harriet Mathias at **Cartier**; Judy Colbert at the **GIA** (Gemological Institute of America); Benjamin Macklowe and Antonio Virardi at the **Macklowe Gallery**; Sonya Newell-Smith at the **Tadema Gallery**; Kealy Gordon and Ellen Nanney at the **Smithsonian Institution**; Megan Taylor at **Luped** for picture research assistance.

The publisher would like to thank the following for their kind permission to reproduce their photographs:

(Key: a-above; b-below/bottom; c-centre; f-far; l-left; r-right; t-top)

Smithsonian Institution, Washington, DC: Cooper-Hewitt, National Design Museum 215cr, 215bl, National Museum of Natural History / Chip Clark 5tr, 6ftl, 27 (C), 46, 54tr, 54br, 56tl, 70, 71bc, 72fbr, 76fcr, 77tl, 113tl, 116c, 132, 152tl, 152cr, 159br, 161tr, 161fcr, 169bl, 170tl, 171br, 206bl, 209br, 216fcl, 233cr, 240fbr, 243cl, 259bl, 285bl, 332c, 332crb, 333crb, National Museum of Natural History / Ken Larsen 95bl, 98fcr, 105bl, 117bc, 168cl, 168cr, 168br, 168fcr, 197br, 340br, 346crb, National Museum of Natural History / Paula Crevoshay 56cr, 56bc, 73c, 105br, National Museum of Natural History / Sena Dyber 138l, 345clb, Sherris Cottier Shank 245cra

2 Courtesy of Sotheby's Picture Library, London: Private Collection. **4 Fellows Auctioneers. Sothebys Inc. 5 akg-images:** (tl). **Fellows Auctioneers. Getty Images:** Peter Macdiarmid (ftl). **6 Bridgeman Images:** De Agostini Picture Library / E. Lessing (tl). **© Cartier. 7 The Al-Thani Collection:** Servette Overseas Ltd 2012, all rights reserved. Photographs taken
by Prudence Cuming Associates Ltd (tr). **Alamy Stock Photo:**Ian Dagnall (tl); Adam Eastland Art + Architecture (ftr). **Dorling Kindersley:** Holts (ftl). **9 © Cartier. 11 Dorling Kindersley:** Holts. **12 Dorling Kindersley:** Natural History Museum, London (clb). **13 Dorling Kindersley:** Tim Parmenter / Natural History Museum, London (cr). **14 Dorling Kindersley:** Natural History Museum, London (clb). **15 Dorling Kindersley:** Holts (cl, ca, fbl, bc/A, fbr, br); Ruth Jenkinson (bl). **Science Photo Library:** Dirk Wiersma (bc/B). **16 Dorling Kindersley:** Natural History Museum, London (clb, bc); Holts (cl, bl, br). **Science Photo Library. 16-17 Dorling Kindersley:**Holts (c, b). **17 Dorling Kindersley:** Natural History Museum, London (clb, br); Oxford University Museum of Natural History (cr). **19 Dorling Kindersley:** Natural History Museum, London (cra). **20 Alamy Stock Photo:** Wildlife GmbH (cl). **Dorling Kindersley:** Natural History Museum, London (bl, fcr, fbr); Holts (c, br). **Gemological Institute of America Reprinted by Permission:** Jian Xin (Jae) Liao (fcrb); Robert Weldon / courtesy Dr. E. J. Gübelin Collection (fbl). **Science Photo Library:** Alfred Pasieka (cr). **21 Alamy Stock Photo:** Martin Baumgaertner (l). **Dorling Kindersley:** Natural History Museum, London (G, J, M, N, P); Holts (A, F, L, O, S Q); Richard Leeney (B); Richard Leeney (D); Richard Leeney (H); Richard Leeney (R). **Gemological Institute of America Reprinted by Permission:** Jian Xin (Jae) Liao (K). **Science Photo Library:** Joel Arem (E); Dorling Kindersley / UIG (C). **22 Dorling Kindersley:** Natural History Museum, London (C); Holts (A, B, D, E, F, H, I, J, K, L, M, N, O, P, Q); Ruth Jenkinson (S). **Science Photo Library:** Vaughan Fleming (R). **23 Dorling Kindersley:** Natural History Museum, London (tr, fbl, bc); Holts (cla, cl, c, cr). **Science Photo Library:**Paul Biddle (fcl). **25 Getty Images:** samvaltenbergs (tr). **26 Alamy Stock Photo:** Alan Curtis (c). **Dorling Kindersley:** Natural History Museum, London (cr, bc); Holts (br). **27 123RF.com:** Ingemar Magnusson (H). **Dorling Kindersley:** Natural History Museum, London (I); Holts (A, D, E, F, G, J, L, M, N, O, P, Q, R, S, U, W, X, Y, Z, ZA); Natural History Museum, London / Tim Parmenter (K); Richard Leeney (V). **Gemological Institute of America Reprinted by Permission:** Robert Weldon / courtesy Minerales y Metales del Oriente, Bolivia, SA (T). **29 Dorling Kindersley:** Natural History Museum, London (tr); Holts (cra, crb, tc, ca, cb, bc). **Fellows Auctioneers. 30 Dorling Kindersley:** Holts (c, cra, bl, br). **31 Gemological Institute of America Reprinted by Permission:** Robert Weldon (br, bl, c, cl, tr); Robert Weldon (bc); Robert Weldon (cr). **32 Bridgeman Images:** Birmingham Museums and Art Gallery (bc); Indianapolis Museum of Art, USA / Gift of Mr. and Mrs. Eli Lilly (cl).**The Art Archive:** Ashmolean Museum (fcla); Musee du Louvre Paris / Kharbine-Tapabor (fcl); Egyptian Museum Cairo / Araldo De Luca (cr). **33 Bridgeman Images:** Christie's Images (ftr); Museo Nazionale del Bargello, Florence, Italy (ftl); State Hermitage Museum, St. Petersburg, Russia (fbl); Weltliche und Geistliche Schatzkammer, Vienna, Austria (cl); De Agostini Picture Library (bl); Fitzwilliam Museum, University of Cambridge, UK (tl); Fitzwilliam Museum, University of Cambridge, UK (tr). **Van Cleef & Arpels. 36 Verdura**. **37 akg-images:** Bildarchiv Steffens (bl). **© Cartier:** (br).**Dorling Kindersley:** Natural History Museum, London (tl). **Getty Images:** Araldo de Luca / Corbis (bc). **38 Bridgeman Images:** De Agostini Picture Library / E. Lessing (bl). **The Trustees of the British Museum. © Cartier. Corbis:** David Lees (ftr). **39 The Trustees of the British Museum:** (bl, bl). **Bulgari:** (fbr). **© Cartier. Dorling Kindersley:** The Trustees of the British Museum (bl). **Fellows Auctioneers. Antonio Virardi of Macklowe Gallery, New York. 39 The Trustees of the British Museum:** (bl, bl). **Bulgari:** (fbr). **© Cartier. Dorling Kindersley:** The Trustees of the British Museum (bl). **Fellows Auctioneers. Antonio Virardi of Macklowe Gallery, New York. 40 akg-images:** Pictures From History. **41 akg-images:** Nimatallah (tl). **Bridgeman Images:** De Agostini Picture Library / Chantilly, Château, Musée Condé (Picture Gallery And Art Museum) (cr); French School, (14th century) / Bibliotheque Municipale, Castres, France (bl). **Muenze Oesterreich AG:** (cl). **42 1stdibs, Inc:**(tl); Macklowe Gallery / Anotonio Virardi (fbr). **Alamy Stock Photo:** David J. Green - technology (bl). **Dorling Kindersley:** Colin Keates / Natural History Museum, London (fcl); Tim Parmenter / Natural History Museum, London (cl). **Fellows Auctioneers. 43 1stdibs, Inc. Bonhams Auctioneers, London. Rijksmuseum Amsterdam:** (tc). **Sothebys Inc. 44 Alamy Stock Photo:** philipus (bl). **Dorling Kindersley:** Holts (fcr); Natural History Museum, London (tl); Natural History Museum, London (fcl); Natural History Museum, London (cr). **Getty Images:** DEA / R.Appiani (cl). **45 1stdibs, Inc. © Cartier. The Goldsmiths' Company:** Leo De Vroomen (tc). **Antonio Virardi of Macklowe Gallery, New York. 47 Bridgeman Images:** (br); Christie's Images (tl). **Corbis:** Leemage (cb). **48 Dorling Kindersley:** Canterbury City Council, Museums and Galleries (br); Ruth Jenkinson (c); University of Pennsylvania Museum of Archaeology and Anthropology (cr). **49 Dorling Kindersley:** Newcastle Great Northern Museum, Hancock (fcr); The Trustees of the British Museum (tl, cl); University of Pennsylvania Museum of Archaeology and Anthropology (cr); University of Pennsylvania Museum of Archaeology and Anthropology (bl). **Dreamstime.com:** Wojpra (br). **50 Photo Scala, Florence:** Marie Mauzy. **51 akg-images:** Erich Lessing (cl). **Getty Images:** Universal Images Group (tl). **Library of Congress, Washington, D.C.:** (cr). **The Art Archive:** Musée du Louvre Paris / Gianni Dagli Orti (bl). **52 Graff Diamonds**. **53 Bridgeman Images:** Christie's Images (br). **© Cartier. The Royal Collection Trust © Her Majesty Queen Elizabeth II:** 2016 (bc). **Photo Scala, Florence:** bpk, Bildagentur fuer Kunst, Kultur und Geschichte, Berlin (bl). **54 Dorling Kindersley:** Natural History Museum, London (tl, cl, bl); Holts (l, ftr, fcr). **55 Dorling Kindersley:** Holts (t, fcl, fbl, fcr, br). **Science Photo Library:** Vaughan Fleming (cl). **56 Bridgeman Images:** Christie's Images (bl). **Fellows Auctioneers:** (tc, tr). **57 Bridgeman Images:** Private Collection / Photo © Christie's Images (br). **© Cartier. Dorling Kindersley:** Holts (fcl). **Fellows Auctioneers. Getty Images:** Peter Macdiarmid (bc). **Tadema Gallery:** (bl). **Van Cleef & Arpels:** (cr). **58 The Royal Collection Trust © Her Majesty Queen Elizabeth II**. **59 Alamy Stock Photo:** V&A Images (cl). **Bibliothèque nationale de France, Paris:** (cr). **The Royal Collection Trust © Her Majesty Queen Elizabeth II:** 2016 (tl, bl). **60-61 The Trustees of the British Museum. 61 Bridgeman Images:** Egyptian National Museum, Cairo, Egypt (br). **62 Corbis:** Smithsonian Institution. **63 Corbis:** Smithsonian Institution (tl); Leemage (cl). **Library of Congress, Washington, D.C.:** (bc). **Museum National d'Histoire Naturelle:** François Farges (cr). **65 Dorling Kindersley:** Holts. **66 Dorling Kindersley:** Ruth Jenkinson / Holts (cl, br). **67 Dorling Kindersley:** Tim Parmenter / Natural History Museum, London (bc). **68 The Royal Collection Trust © Her Majesty Queen Elizabeth II:** 2016. **69 Bridgeman Images:** Her Majesty Queen Elizabeth II, 2016 (bc); Chetham's Library, Manchester, UK (tl); Walker, Robert (1607-60) / Leeds Museums and Galleries (Leeds Art Gallery) U.K. (cr). **71 Bridgeman Images:** Kremlin Museums, Moscow, Russia (bl). **© Cartier. 72 Alamy Stock Photo:** Rhea Eason (cl); ZUMA Press, Inc (bl); Greg C Grace (ftr). **Dorling Kindersley:** Natural History Museum, London (ftl, c, cr); Holts (tl, tr). **Science Photo Library:** Joel Arem (br). **73 Dorling Kindersley:** Holts (br, fbr); Judith Miller / Sloane's (fbl). **Fellows Auctioneers. 74 Getty Images:** STF. **75 Dulong Fine Jewellery:** Sara Lindbaek (tl, bl). **Getty Images:** Print Collector (c). **Rex by Shutterstock:** Tim Rooke (cr). **76 Dorling Kindersley:** Holts (l, cl, cr).**Antonio Virardi of Macklowe Gallery, New York. 77 © Cartier. Dorling Kindersley:** Holts (bc); Tim Parmenter / Natural History Museum, London (br). **Fellows Auctioneers.**. **Antonio Virardi of Macklowe Gallery, New York. 78 Alamy Stock Photo:** V&A Images. **79 Alamy Stock Photo:** Dinodia Photos (cr). **The Royal Collection Trust © Her Majesty Queen Elizabeth II:** 2016 (tl, cl). **80 Dorling Kindersley:** Colin Keates / Natural History Museum, London (cr); Tim Parmenter / Natural History Museum, London (tl, c); Holts (bl). **The Royal Collection Trust © Her Majesty Queen Elizabeth II:** 2016 (br). **81 1stdibs, Inc. © Cartier. Dorling Kindersley:** Holts (tl, bc); Tim Parmenter / Natural History Museum, London (fcl). **Gemological Institute of America Reprinted by Permission:** Robert Weldon / Ring courtesy of a Private Collector and Mona Lee Nesseth, Custom Estate Jewels (tc). **82 Alamy Stock Photo:** Granger, NYC. **83 Bridgeman Images:** Tretyakov Gallery, Moscow, Russia (bl); Kremlin Museums, Moscow, Russia (c). **Getty Images:** Leemage (tl); Mondadori Portfolio (cr). **84 Dorling Kindersley:** Natural History Museum, London (c, fbl, cl); Holts (cr, bc, br). **85 1stdibs, Inc. © Cartier. Dorling Kindersley:** Natural History Museum, London (c, bl). **Gemological Institute of America Reprinted by Permission. Tadema Gallery. 86 Dorling Kindersley:** Natural History Museum, London (br); Ruth Jenkinson (bc). **87 Bonhams Auctioneers, London:** (cr). **Dorling Kindersley:** Natural History Museum, London (fcl, bc). **Gemological Institute of America Reprinted by Permission. 88 Alamy Stock Photo:** Annie Eagle (bl); Universal Images Group North America LLC / DeAgostini (tl). **Dorling Kindersley:** Tim Parmenter / Natural History Museum, London (bc, br). **89 Dorling Kindersley:** Oxford University Museum of Natural History (br). **Getty Images:** Matteo Chinellato - Chinellato Photo (tl, cr). **90 © Cartier. 91 Bridgeman Images:** Archives Charmet (cr); Christie's Images (cla, bc). **© Cartier. Getty Images:** Universal History Archicve / UIG (fcra). **92 The Al-Thani Collection:** Servette Overseas Ltd 2012, all rights reserved. Photographs taken by Prudence Cuming Associates Ltd (tl, cra, bl, clb). **Van Cleef & Arpels. 92-93 The Al-Thani Collection:** Servette Overseas Ltd 2012, all rights reserved. Photographs taken by Prudence Cuming Associates Ltd (b). **93 The Al-Thani Collection:** Servette Overseas Ltd 2012, all rights reserved. Photographs taken by Prudence Cuming Associates Ltd (c, t). **94 Alamy Stock Photo:** Eddie Gerald (bl). **Bonhams Auctioneers, London:** (fcr, br). **Corbis. Dorling Kindersley:** Holts (fcl, cl). **96 Dorling Kindersley:** Holts (br). **97 Dorling Kindersley:** Colin Keates / Natural History Museum, London (cl); Tim Parmenter / Natural History Museum, London (bc). **98 Alamy Stock Photo:** imageBROKER (bl). **Corbis. Dorling Kindersley:** Natural History Museum, London (tl). **99 Alamy Stock Photo:** Goran Bogicevic (bl). **Dorling Kindersley:** Oxford University Museum of Natural History (cl); Tim Parmenter / Natural History Museum, London (fbl). **Dreamstime.com:** (fbr). **100 Bonhams Auctioneers, London. Dorling Kindersley:** Ruth Jenkinson (cl,

fcr). **101 Dorling Kindersley:** Natural History Museum, London (cl, bc). **Getty Images:** Print Collector (br). **102-103 Alamy Stock Photo:** Susana Guzman. **104 Alamy Stock Photo:** The Natural History Museum (bl); Universal Images Group North America LLC / DeAgostini (c); Valery (cr). **105 Alamy Stock Photo:** PjrStudio (cr). **106 Dorling Kindersley:** Natural History Museum, London (bc). **Getty Images:** Universal History Archive (bl). **107 Dorling Kindersley:** Natural History Museum, London (bc); Ruth Jenkinson (cl, br/pendant, r). **108 Alamy Stock Photo:** Heritage Image Partnership Ltd. **109 Alamy Stock Photo:** SilverScreen (crb); Lilyana Vynogradova (ca). **Nordiska Museet:** Mats Landin (tl, bl). **110 Dorling Kindersley:** Holts (br, tl, cl, bc, cr); Tim Parmenter / Natural History Museum, London (bl). **111 Dorling Kindersley:** Holts (tc, tl). **Fellows Auctioneers. Tadema Gallery. 112 akg-images**. **113 Corbis:**Underwood & Underwood (br). **RMN:** Gérard Blot (cr); Jean-Gilles Berizzi (bl). **114 Bridgeman Images:** Natural History Museum, London, UK (G). **Dorling Kindersley:** Natural History Museum, London (F); Holts (H); Holts (C); Holts (E, D, K). **Dreamstime.com:** Nastya81 (A). **115 Alamy Stock Photo:** Jon Helgason (B). **Bridgeman Images:** Natural History Museum, London, UK (N). **Dorling Kindersley:** Natural History Museum, London (H, I, L); Natural History Museum, London (E); Holts (M); Holts (C, tr/D, K, A, F). **Getty Images:** t_kimura (G). **116 Alamy Stock Photo:** SPUTNIK (bl); Universal Images Group North America LLC / DeAgostini (tl, br). **Dorling Kindersley:** Natural History Museum, London (cl); Natural History Museum, London (cr). **117 Dorling Kindersley:** Natural History Museum, London (cr); Natural History Museum, London (br). **118 Dorling Kindersley:** Natural History Museum, London (cr, fbl, bl, br); Holts (fbr). **119 Alamy Stock Photo:** John Cancalosi (bc); Valery Voennyy (bl). **Dorling Kindersley:** Natural History Museum, London (br). **120 Alamy Stock Photo:** blickwinkel (c). **Dorling Kindersley:** Natural History Museum, London (br, fbr). **Science Photo Library:** Larry Berman (bl). **121 Alamy Stock Photo:** Karol Kozlowski (cr); rep0rter (cl); Universal Images Group North America LLC / DeAgostini (fcr); PjrStudio (br). **Dorling Kindersley:** Natural History Museum, London (bl). **122 Alamy Stock Photo:** geoz (cl, fcl); Andrew Holt (bl). **Bonhams Auctioneers, London. Corbis. Dorling Kindersley:** Durham University Oriental Museum (cr); University of Pennsylvania Museum of Archaeology and Anthropology (bc). **123 Alamy Stock Photo:** Fabrizius Troy (br). **Dorling Kindersley:** Natural History Museum, London (tl); Ruth Jenkinson (bc).**124-125 Bridgeman Images:** Lukas - Art in Flanders VZW / Photo: Hugo Maertens. **126 Alamy Stock Photo:** John Cancalosi (cl); RF Company (tl); Corbin17 (bc). **Corbis:** (bl); Visuals Unlimited (cr).**Dorling Kindersley:** Natural History Museum, London (br). **127 1stdibs, Inc. Alamy Stock Photo:** Oleksiy Maksymenko (cr); Steve Sant (cl). **Dorling Kindersley:** Natural History Museum, London (fcl, fcr). **128 Bridgeman Images:** Walker Art Gallery, National Museums Liverpool. **129 Bridgeman Images:** Victoria & Albert Museum, London, UK / The Stapleton Collection (bl); Walker Art Gallery, National Museums Liverpool (tl). **Corbis:** Heritage Images (crb). **Van Cleef & Arpels. 130 123RF.com:** Michał Barański (ca); Laurent Renault (c). **Bridgeman Images:** Christie's Images (tl). **Dorling Kindersley:** Natural History Museum, London (br); Holts (fcl, clb); Holts (bl). **130-131 Dorling Kindersley:** Ruth Jenkinson (cb). **131 123RF.com:** Dipressionist (ftl). **Bridgeman Images:** Natural History Museum, London, UK (tr). **Dorling Kindersley:** Holts (ftr, cr); Natural History Museum, London (cb). **133 Bridgeman Images:** Purchase from the J. H. Wade Fund (bl). **© Cartier. V&A Images / Victoria and Albert Museum, London. 134 Bridgeman Images:** Natural History Museum, London, UK (bl). **Dorling Kindersley:** Natural History Museum, London (cr); Holts (tl, tc). **135 Dorling Kindersley:**Natural History Museum, London (c, fbl, bl); Holts (cr, br, fbr). **Science Photo Library:** Mark A. Schneider (tc). **136 Dorling Kindersley:** Natural History Museum, London (ftl, tr, ftr, c); Holts (bl). **Science Photo Library:** Natural History Museum, London (br). **137 Alamy Stock Photo:** Universal Images Group North America LLC / DeAgostini (cr). **Dorling Kindersley:** Natural History Museum, London (tc, cl, fbr); Holts (tl, c, fbl, bl, br). **138 Bridgeman Images:** Heini Schneebeli (tr). **Fellows Auctioneers:** (br). **Tadema Gallery:** (cr). **139 Bridgeman Images:** Boltin Picture Library (br). **Dorling Kindersley:**Natural History Museum, London (bl); Holts (cr); Judith Miller / Private Collection (bc). **Fellows Auctioneers:** (tl, cl, c). **140 Photo Scala, Florence:** bpk, Bildagentur fuer Kunst, Kultur und Geschichte, Berlin. **141 akg-images:** (cr); Erich Lessing (tl). **Alamy Stock Photo:** Prisma Bildagentur AG (bl). **Photo Scala, Florence:** bpk, Bildagentur fuer Kunst, Kultur und Geschichte, Berlin (cl). **142 Dorling Kindersley:** Holts (bl, fcr, fbl); Natural History Museum, London (fbr). **RMN:** Droits réservés (cl). **Science Photo Library:** Natural History Museum, London (br, clb). **142-143 Dorling Kindersley:** Harry Taylor (t). **143 Alamy Stock Photo:** Mykola Davydenko (br). **Dorling Kindersley:** Natural History Museum, London (ca); Ruth Jenkinson (tr); Harry Taylor (cr). **Dreamstime.com:** Ismael Tato Rodriguez (cb). **144 Bayerische Schlösserverwaltung:** Maria Scherf / Rainer Herrmann, München. **145 Getty Images:** DEA / A. DeGregorio (cr); Imagno (tl); Heritage Images (cl); Print Collector (bl). **146 Bonhams Auctioneers, London**. **147 Alamy Stock Photo:** The Art Archive (bl); World History Archive (bc). **148 Alamy Stock Photo:** bilwissedition Ltd. & Co. KG (bl); Universal Images Group North America LLC / DeAgostini (br). **Bonhams Auctioneers, London:** (cr). **Dorling Kindersley:** Holts (bc); Natural History Museum, London / Tim Parmenter (cl). **149 1stdibs, Inc. Bonhams Auctioneers, London. Dorling Kindersley:** Holts (tl, ftl). **150 V&A Images / Victoria and Albert Museum, London:** (tl, tc, tr). **151 Bridgeman Images:** (crb); Look and Learn (bc). **V&A Images / Victoria and Albert Museum, London. 152 Dorling Kindersley:** Holts (bl, c, br). **153 Dorling Kindersley:** Natural History Museum, London (fcl, cl, fbr); University of Pennsylvania Museum of Archaeology and Anthropology (ftl); Oxford University Museum of Natural History (tl); Holts (tr, cr). **Fellows Auctioneers. 154 Dorling Kindersley:** Natural History Museum, London (tl, cl, c, br); Holts (cr, fbr). **155 © Cartier. Dorling Kindersley:** Natural History Museum, London (bl, fcr); Holts (bc). **Fellows Auctioneers. 156-157 Bridgeman Images**. **158 © Cartier. 159 Bridgeman Images:** (bl); Christie's Images (bc). **Gemological Institute of America Reprinted by Permission:** Thomas Cenki (tl). **160 Alamy Stock Photo:** Zoonar GmbH (ftr). **Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (ftl); Holts (tl, tr, fbr). **161 1stdibs, Inc. © Cartier. Fellows Auctioneers. Tadema Gallery. Van Cleef & Arpels. 162 Bonhams Auctioneers, London. 163 Alamy Stock Photo:** AF Fotografie (cr). **Gayle Beveridge:** (bl). **Bonhams Auctioneers, London. 164 Dorling Kindersley:** Colin Keates / Natural History Museum, London (fbl); Tim Parmenter / Natural History Museum, London (tl, fcl); Holts (cr, fcr, br, fbr). **Gemological Institute of America Reprinted by Permission. 165 © Cartier. Dorling Kindersley:** Holts (tl). **Fellows Auctioneers. Tadema Gallery. 166 Corbis:** Marc Dozier (cla). **Dorling Kindersley:** Holts (clb); Holts (br). **Science Photo Library:** (bc). **167 Alamy Stock Photo:** John Cancalosi (br). **Dorling Kindersley:** Natural History Museum, London (bl). **Gemological Institute of America Reprinted by Permission:** Jeff Scovil (ca). **Science Photo Library. 168 Dorling Kindersley:** Natural History Museum, London (fcl); Ruth Jenkinson (bl). **169 Dorling Kindersley:** Holts (cl, bc); Ruth Jenkinson (cr). **170 Alamy Stock Photo:** The Natural History Museum (bc). **Dorling Kindersley:** Natural History Museum, London (cl, br, fcr); Holts (cr/Cabochon). **171 Dorling Kindersley:** Natural History Museum, London (tl, bl, bc). **172 Dorling Kindersley:** Natural History Museum, London (bl, br). **173 Alamy Stock Photo:** Susan E. Degginger (fbl); Siim Sepp (cl). **Getty Images:** Ron Evans (cr). **iRocks.com/Rob Lavinsky Photos:** (fcr). **174 David Webb**. **175 Bridgeman Images:** Ashmolean Museum, University of Oxford, UK (bc); Egyptian National Museum, Cairo, Egypt (bl). **© Cartier. Dorling Kindersley:** Holts (tl). **176 Alamy Stock Photo:** The Art Archive (fbr); Interfoto (fcr). **Dorling Kindersley:** Natural History Museum, London (cl, cr/Cabochon); Holts (tl, tc, tr, fcl). **Science Photo Library:** Joel Arem (br). **177 1stdibs, Inc. Bulgari. Fellows Auctioneers. Getty Images:** DEA / A. Dagli Orti (tr); Mark Moffet / Minden Pictures (cl).**178 Bridgeman Images:** Boltin Picture Library (cl). **Dorling Kindersley. Getty Images:** DEA / S. Vannini (br). **179 Bridgeman Images. The Trustees of the British Museum. Dorling Kindersley:**Durham University Oriental Museum (fcr); University of Pennsylvania Museum of Archaeology and Anthropology (crb); University of Pennsylvania Museum of Archaeology and Anthropology (cr). **180 Dorling Kindersley:** Natural History Museum, London (bl); The Science Museum, London (fcr); Ruth Jenkinson (fcl, br); Natural History Museum, London / Tim Parmenter (tl). **181 Bonhams Auctioneers, London. Bridgeman Images:** De Agostini Picture Library (bc). **Dorling Kindersley:** Natural History Museum, London (tl, fcl). **iRocks.com/Rob Lavinsky Photos. 182 Bridgeman Images:** Louvre-Lens, France. **183 Alamy Stock Photo:** Everett Collection Historical (cla). **Bridgeman Images:** Christie's Images (tl); Tallandier (crb). **TopFoto.co.uk:** Woodmansterne (bl). **184 Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (fcr, bl). **Gemological Institute of America Reprinted by Permission:** Robert Weldon (fbl). **Science Photo Library:** Science Stock Photography (cr). **185 Alamy Stock Photo:** Lanmas (br); Universal Images Group North America LLC / DeAgostini (cl). **Gemological Institute of America Reprinted by Permission. iRocks.com/Rob Lavinsky Photos. 186 Science Photo Library:** Mark a. Schneider (tc); Natural History Museum, London (cl). **187 Science Photo Library:** Mark a. Schneider (cr). **188-189 Bridgeman Images:** Werner Forman Archive. **190 Corbis:** Scientifica (tl). **Dorling Kindersley:** Natural History Museum, London (fbl, cr, fbr); The University of Aberdeen (fcr); Ruth Jenkinson (bl).**191 Corbis:** Scientifica (cl). **Dorling Kindersley:** Durham University Oriental Museum (tl); Pennsylvania Museum of Archaeology and Anthropology (cr, fcr); Natural History Museum / Colin Keates (fcl).**192 Bonhams Auctioneers, London. Gemological Institute of America Reprinted by Permission:** Nathan Renfro (bl); Robert Weldon (fbr); Kevin Schumacher (tl). **Getty Images:** Matteo Chinellato - ChinellatoPhoto (cr). **193 Alamy Stock Photo:** Universal Images Group North America LLC / DeAgostini (tl). **Dorling Kindersley:** Natural History Museum, London (fbl, cl). **194 Bridgeman Images:**Christie's Images. **195 Alamy Stock Photo:** GL Archive (cl). **Bridgeman Images:** Christie's Images (tl). **Corbis:** Chris Wallberg / dpa (crb). **Getty Images:** Universal History Archive (bl). **196 Bonhams Auctioneers, London. Bridgeman Images:** Private Collection / Ken Welsh (bc). **Dorling Kindersley:** Ruth Jenkinson (cl). **197 Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (cl); Tim Parmenter / Natural History Museum, London (tl). **Getty Images:** Ron Evans (cr). **198 Bridgeman Images:** Yale Center for British Art, Paul Mellon Collection, USA (clb).**Dorling Kindersley:** Natural History Museum, London (cr); Tim Parmenter / Natural History Museum, London (tl); Ruth Jenkinson (cl, br); Harry Taylor (fcl). **199 Alamy Stock Photo:** Corbin17 (cr).**Dorling Kindersley:** Natural History Museum, London (cl, bc); Tim Parmenter / Natural History Museum, London (tl, c). **Gemological Institute of America Reprinted by Permission:** Robert Weldon (bl). **200-201 Getty Images:** Handout. **202 123RF.com:** Valentin Kosilov (cr). **Alamy Stock Photo:** Alan Curtis / LGPL (c); Susan E. Degginger (bl). **Dorling Kindersley:** (cl); Tim Parmenter / Natural History Museum, London (br, bc); Harry Taylor (tl). **203 Dorling Kindersley:** Natural History Museum, London (cr); Holts (fcr). **Fellows Auctioneers. 204 Alamy Stock Photo:** Blend Images (bl).**Corbis. Dorling Kindersley:** Natural History Museum, London (tl, br, fbr). **Getty Images:** Ron Evans (fcr). **205 123RF.com:** vvoennyy (tl, cl). **Dorling Kindersley:** Oxford University Museum of Natural History (fcl). **Getty Images:** Arpad Benedek (br); Ron Evans (bl). **206 Dorling Kindersley:** Natural History Museum, London (tl, cla). **207 Dorling Kindersley:** Holts (cla); Ruth Jenkinson (tl); Ruth Jenkinson (tc, cra); Holts (c). **Science Photo Library:** Millard H. Sharp (bl). **208 Alamy Stock Photo:** Universal Images Group North America LLC / DeAgostini (br). **Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (cl); Ruth Jenkinson (bl). **209 Bonhams Auctioneers, London. Dorling Kindersley:** Holts (tl, cl, cr). **210 © Cartier. 211 © Cartier. Getty Images:**Cecil Beaton (bl); Alfred Eisenstaedt (cr). **Van Cleef & Arpels. 212 Dorling Kindersley:** Holts (tl, fcr, fcl); Natural History Museum, London (br); Holts (fbr). **Getty Images:** UniversalImagesGroup (bl).**213 Dorling Kindersley:** Holts (cl); Holts (bc). **Fellows Auctioneers. Kent Raible:** kentraible.com (c). **Tadema Gallery. 214 Bridgeman Images:** Pictures from History. **215 Bridgeman Images:**Pictures from History (tl). **images reproduced courtesy of Powerhouse Museum:** Gift of Mr Alastair Morrison, 1992 (ca). **216 Alamy Stock Photo:** Valery Voennyy (tl). **Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (cr, cl). **217 Alamy Stock Photo:** Nika Lerman (tl). **Bonhams Auctioneers, London. Bridgeman Images:** Vorontsov Palace, Crimea, Ukraine (br). **Corbis. Dorling Kindersley:** Ruth Jenkinson (bl). **218-219 Corbis. 220 Alamy Stock Photo:** Alan Curtis (tl); Greg C Grace (fcr). **Bonhams Auctioneers, London. 221 Alamy Stock Photo:** Universal Images Group North America LLC / DeAgostini (cl). **Bonhams Auctioneers, London. Corbis. 222 Bonhams Auctioneers, London. Bridgeman Images:** Pictures from History (bl).**Dorling Kindersley:** Natural History Museum, London (tl, fcr); Holts (cl). **223 Dorling Kindersley:** Natural History Museum, London (cl, c). **Gemological Institute of America Reprinted by Permission. Science Photo Library:** Natural History Museum, London (bl). **224 Courtesy of Sotheby's Picture Library, London:** Private Collection. **225 Bridgeman Images:** British Royal Family (cr). **Corbis:** Hulton-Deutsch Collection (tl). **Getty Images:** Peter Macdiarmid (tc); Ben Stansall / AFP (bl). **226 Bulgari. 227 Bonhams Auctioneers, London. © Cartier. Dorling Kindersley:** Holts (tl). **228 Alamy Stock Photo:**Arco Images GmbH (fbr). **Dorling Kindersley:** Natural History Museum, London (cl, cr, fbl); Holts (tc, tc/Tourmaline Cut, fcl, bl, br). **229 Bulgari. © Cartier. Dorling**

Kindersley: Holts (c). **Lang Antiques:** (cl). **Tadema Gallery. 230 Photo Scala, Florence:** The Metropolitan Museum of Art / Art Resource. **231 Bridgeman Images:** Bolivar Museum, Caracas, Venezuela (cr). **Getty Images:**Universal History Archive (cla). **Photo Scala, Florence:** (bl); The Metropolitan Museum of Art / Art Resource (tl). **232 Alamy Stock Photo:** Zoonar GmbH (tl). **Dorling Kindersley:** Natural History Museum, London (bc); Holts (c, bl). **233 Bonhams Auctioneers, London. © Cartier. Van Cleef & Arpels. 234 akg-images:** The British Library Board. **235 akg-images:** Album / Oronoz (bl). **Alamy Stock Photo:** Moviestore collection Ltd (fcr). **Bridgeman Images:** Topkapi Palace Museum, Istanbul, Turkey (tl). **Corbis:** R. Hackenberg (crb). **photographersdirect.com:** (c). **236 The Trustees of the British Museum**. **237 Bridgeman Images:** Christie's Images (br); Kremlin Museums, Moscow, Russia (bl). **The Trustees of the British Museum. Dorling Kindersley:** Natural History Museum, London (tl). **238 Dorling Kindersley:** Colin Keates (tr); Holts (tl, c); Natural History Museum, London (tc, cl). **239 Dorling Kindersley:** Natural History Museum, London (cr); Holts (tl, c, fbl, bl, br/Morganite).**iRocks.com/Rob Lavinsky Photos. 240 1stdibs, Inc. Bonhams Auctioneers, London:** (tl, bl). **Bridgeman Images:** Christie's Images (fcr). **© Cartier. Dorling Kindersley:** Holts (fbl). **241 1stdibs, Inc. Bonhams Auctioneers, London:** (cl). **© Cartier. 242 Getty Images:** Brendan Smialowski / AFP. **243 Atelier Munsteiner:** (tl). **Bridgeman Images:** Christie's Images (cr). **244 Atelier Munsteiner. Alice Cicolini:** (bc). **Michael M. Dyber:** Sena Dyber (br). **245 © Cartier. Michael M. Dyber:** Sena Dyber (l, c, br). **246 Bonhams Auctioneers, London:** (fcl, cl, cr, br). **Dorling Kindersley:** Natural History Museum, London (bc). **Getty Images:** DEA / R. APPIANI (bl). **247 Alamy Stock Photo:** Universal Images Group North America LLC / DeAgostini (fbr). **Bonhams Auctioneers, London:** (fcl).**Dorling Kindersley:** Natural History Museum, London (cr, fbl, bl). **Gemological Institute of America Reprinted by Permission:** Robert Weldon (tl, br). **248-249 Alamy Stock Photo:** Hemis. **249 Photo Scala, Florence:** The Metropolitan Museum of Art / Art Resource (bc). **Courtesy of Sotheby's Picture Library, London:** Private Collection (br). **250 Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (fcl); Ruth Jenkinson (bl). **Getty Images:** Corbis / Ron Evans / Ocean (cl). **251 123RF.com:** Chatchai Chattranusorn (bl). **Alamy Stock Photo:** Aysegul Muhcu (br). **Dorling Kindersley:** Natural History Museum, London (tl, bc). **Getty Images:** (cl); Mark Schneider (cr). **252 Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (tl, bc). **Gemological Institute of America Reprinted by Permission:** Robert Weldon (cr); Robert Weldon (br); Robert Weldon (fcr). **253 Alamy Stock Photo:** Nika Lerman (br). **Dorling Kindersley:** Natural History Museum, London (fcl, cl, cr); Holts (fcr). **Fellows Auctioneers. 254 Dorling Kindersley:** Natural History Museum, London (c); Holts (tl, br). **255 Alamy Stock Photo:**INTERFOTO (br). **Bonhams Auctioneers, London. Dorling Kindersley:** Holts (fcl, fcr). **256 Getty Images:** JTB Photo. **257 Alamy Stock Photo:** Kumar Sriskandan (bl). **Bridgeman Images:** Pictures from History (c). **Corbis:** Melvyn Longhurst (tl). **Getty Images:** Keystone (cr). **258 Bridgeman Images:** Walters Art Museum, Baltimore, USA. **259 Fabergé:** (br). **Tadema Gallery:** (bc). **260 Dorling Kindersley:** Natural History Museum, London (tl, ftr); Oxford University Museum of Natural History (fcl); Holts (tr, cr, fcr, bc, br). **261 Dorling Kindersley:** Natural History Museum, London (fbl); Holts (cl, tr, fbr). **Science Photo Library:** Joel Arem (br). **262 1stdibs, Inc. Bridgeman Images:** Christie's Images (br); Private Collection / Photo © Christie's Images (fbl). **The Trustees of the British Museum. © Cartier. Dorling Kindersley:** Holts (tl, cl). **Fellows Auctioneers:** (bl). **263 1stdibs, Inc. Bridgeman Images:** Christie's Images (tr). **Bulgari. © Cartier. Dorling Kindersley:** Holts (ftl, fcl, fbl). **264 Universal News And Sport:** Birmingham Museums Trust. **265 Alamy Stock Photo:** World History Archive (tl, c, bl). **The Trustees of the British Museum. Getty Images:** George Munday / Design Pics / Corbis (cr). **266 Dorling Kindersley:** Natural History Museum, London (c); Natural History Museum, London (clb); Natural History Museum, London (bl); Holts (tl, bc). **266-267 Dorling Kindersley:** Holts (c). **267 123RF.com:** Vvoennyy (bc). **Dorling Kindersley:** Holts (bl, tl); Ruth Jenkinson (tc, cra); Holts (crb). **268 Dorling Kindersley:** Natural History Museum, London (cl, c); Holts (tl, bl, r). **269 1stdibs, Inc. Bonhams Auctioneers, London. Dorling Kindersley:** Holts (tl, fcl, bl, fcr). **270 Bridgeman Images:** J. Paul Getty Museum, Los Angeles, USA. **271 Alamy Stock Photo:**Oldtime (cr); Universal Art Archive (tl). **Corbis:** Stapleton Collection (bc). **Rex by Shutterstock:** Nils Jorgensen (cl). **272 Dorling Kindersley:** Natural History Museum, London (tl, r); Holts (bc).**Gemological Institute of America Reprinted by Permission:** Eric Welch (cl). **273 Bonhams Auctioneers, London. Dorling Kindersley:** Holts (tl, cl, bl, bc). **274 1stdibs, Inc. Alamy Stock Photo:**Stela Knezevic (cl). **Dorling Kindersley:** Natural History Museum, London (tl, cr, bl); Oxford University Museum of Natural History (fcl); Holts (fcr). **275 Gemological Institute of America Reprinted by Permission:** Robert Weldon (br). **Science Photo Library:** Dorling Kindersley / UIG (tl). **276 Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (cl, bl, br).**Gemological Institute of America Reprinted by Permission. Science Photo Library:** Natural History Museum, London (cr). **277 123RF.com:** Vvoennyy (bl, tl). **Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (c, bc). **278 The Walters Art Museum, Baltimore:** Acquired by Henry Walters, 1930 / Photographer Susan Tobin. **279 Corbis:** Historical Picture Archive (bl). **Getty Images:** DEA / G. Dagli Orti (crb); Print Collector (cr). **Press Association Images:** ABACA Press (tr, ca). **280 Bonhams Auctioneers, London:** (cr, br). **Dorling Kindersley:** Ruth Jenkinson (tl, c). **Dreamstime.com:** David Porter (bl). **281 Bonhams Auctioneers, London:** (tl, br). **Dorling Kindersley:** Natural History Museum, London (bl). **282 Bonhams Auctioneers, London:**(c). **Dorling Kindersley:** Natural History Museum, London (cl, bc, r). **Science Photo Library:** Natural History Museum, London (tl). **283 Bonhams Auctioneers, London:** (tl, c). **Dorling Kindersley:**Natural History Museum, London (bl, cr). **Gemological Institute of America Reprinted by Permission:** Robert Weldon (bc); Robert Weldon (br). **284 Bridgeman Images:** De Agostini Picture Library / G. Cigolini. **285 Alamy Stock Photo:** AF Fotografie (c). **Corbis:** Marc Dozier (tl). **Getty Images:** Jean-Claude Deutsch / Paris Match (cr). **286 Bridgeman Images:** Natural History Museum, London, UK (tr). **Dorling Kindersley:** Holts (cla, cr, tr/Emerald); Holts (ca). **Science Photo Library:** (tc); Dorling Kindersley / UIG (clb). **286-287 Dorling Kindersley:** Holts (c). **288 Corbis:** Michele Falzone / JAI.**289 Alamy Stock Photo:** PRISMA ARCHIVO (cl). **Bridgeman Images:** Abate, Niccolo dell' (c.1509-71) / Galleria Estense, Modena, Italy / Ghigo Roli (bc). **Corbis:** (tl). **Getty Images:** Bettmann / Corbis (cr). **291 Dorling Kindersley:** Ruth Jenkinson (c). **292 V&A Images / Victoria and Albert Museum, London. 293 Bridgeman Images:** Christie's Images (bc, br, bl). **Gemological Institute of America Reprinted by Permission. 294 Bonhams Auctioneers, London. Bridgeman Images:** Christie's Images (fcr, fbr). **Dorling Kindersley:** Natural History Museum, London (cl); Holts (c). **Fellows Auctioneers:** (tr). **295 AB JEWELS Ltd.:** (cl). **© Cartier. Mikimoto:** (bl). **Antonio Virardi of Macklowe Gallery, New York. YOKO London:** (br). **296 Alamy Stock Photo:** Ian Dagnall. **297 Bridgeman Images. Rex by Shutterstock:** SNAP (bl). **298 Mary Evans Picture Library:** Alinari Archives, Florence - Reproduced with the permission of Ministero per i Beni e le Attivit… Cu (c). **The Art Archive:**DeA Picture Library (cr/r). **299 Alamy Stock Photo:** Graham Clarke (cl). **Dorling Kindersley:** Jewellery design Maya Brenner (cr); Ruth Jenkinson (bl). **Fellows Auctioneers. V&A Images / Victoria and Albert Museum, London. 300 The Trustees of the British Museum. 301 Bridgeman Images. Corbis:** 145 / Burazin / Ocean (tl). **Getty Images:** Time Life Pictures (cr). **302-303 Harry Winston**.**304 Dorling Kindersley:** CONACULTA-INAH-MEX. **305 Alamy Stock Photo:** Aurora Photos (c); Granger, NYC. (tl). **Corbis:** Robert Harding Productions (crb). **Dorling Kindersley:** CONACULTA-INAH-MEX (bl). **Getty Images:** DEA / G. Dagli Orti (cr). **306 Dorling Kindersley:** Natural History Museum, London (cr, fbr); Holts (cl). **Getty Images:** Print Collector (bl). **307 1stdibs, Inc. Dorling Kindersley:** Natural History Museum, London (cl, cr, fcr); Holts (tc). **308 Alamy Stock Photo:** The Natural History Museum (br); PjrStudio (bl). **Dorling Kindersley:** Ruth Jenkinson (cl, bc). **309 Alamy Stock Photo:** Siim Sepp (cl). **Dorling Kindersley:** Natural History Museum, London (tl). **Getty Images:** Don Emmert (br); Ron Evans (bc). **310 Alamy Stock Photo:** Evgeny Parushin (fcr); David Sanger photography (bl). **Dorling Kindersley:** Holts (br); Oxford University Museum of Natural History (cl). **311 Alamy Stock Photo:** Editorial (br). **Dorling Kindersley:** Holts (cr). **iStockphoto.com:**desnik (tc). **Tadema Gallery. 312 akg-images:** Ruhrgas AG. **313 akg-images:** Ruhrgas AG (bl); Universal Images Group / Sovfoto (tl). **Photo Scala, Florence:** Photo Josse (cr). **TopFoto.co.uk:** RIA Novosti (cl). **314 Dorling Kindersley:** Natural History Museum, London (c); Holts (bl, cr, br). **315 Bridgeman Images:** (br). **Dorling Kindersley:** Holts (tl, tc, c); Judith Miller / Christbal (cl). **Fellows Auctioneers. Getty Images:** Christie's Images (cr). **316 Bayerische Schlösserverwaltung:** Maria Scherf / Rainer Herrmann, München. **317 Alamy Stock Photo:** DBI Studio (fcr). **Getty Images:** NY Daily News Archive (bl). **Photo Scala, Florence:** 2016. Image copyright The Metropolitan (tl). **Courtesy of Sotheby's Picture Library, London. 318 Bonhams Auctioneers, London. Geology.com:**(tl). **Roland Smithies / luped.com. 319 Alamy Stock Photo:** Age Fotostock (br). **Dorling Kindersley:** Natural History Museum, London (bc); Holts (bl). **321 Dreamstime.com:** Milahelp S.r.o.. **322 Alamy Stock Photo:** Universal Images Group North America LLC / DeAgostini (bl); WILDLIFE GmbH (fcr). **Dorling Kindersley:** Natural History Museum, London (tl, c). **Dreamstime.com:** Milahelp S.r.o. (cr, bc, br). **323 Dorling Kindersley:** Pitt Rivers Museum, Oxford (fbr, br); Natural History Museum, London (tl, fcl, cl); Ruth Jenkinson (fcr, bl); Holts (cr/obsidian). **324 Dorling Kindersley:**Aberdeen (bc); Natural History Museum, London (tl, br); Pennsylvania Museum of Archaeology and Anthropology (bl). **325 Dorling Kindersley:** Aberdeen (cl); Pennsylvania Museum of Archaeology and Anthropology (tl, fcr); Ruth Jenkinson (cr/sandstone). **Dreamstime.com:** Srinakorn Tangwai (bl). **326 Corbis:** Christian Handl. **327 123RF.com:** Patrick Guenette (cl). **Alamy Stock Photo:** PRISMA ARCHIVO (cr). **Corbis:** Free Agents Limited (tl). **iStockphoto.com:** &#169 Bj°rn Gjelsten (bc). **328 1stdibs, Inc. Alamy Stock Photo:** Wladimir Bulgar (cl). **Bridgeman Images. 329 Dorling Kindersley:** Natural History Museum, London (tl, fcl, cl). **330 Alamy Stock Photo:** Adam Eastland Art + Architecture. **331 Bridgeman Images:** Bonhams, London, UK (cla). **Corbis:** (tl, bl). **ICCD – Fondo Ministero della Pubblica Istruzione Gabinetto fotografico della Regia Soprintendenza alle Gallerie:** (crb). **332 Bridgeman Images:** Christie's Images (cl). **Getty Images:** Ishara S. Kodikara (bl). **Rex by Shutterstock:** Universal History Archive / UIG (tr). **Science Photo Library:** Tom McHugh (br). **333 Crater of Diamonds, State Park:** (fcrb). **Kaufmann de Suisse:** (l). **Press Association Images:** AP Photo / Keystone, Laurent Gillieron (cra). **334-335 © Cartier. 337 Dorling Kindersley:** Holts (c). **338 Alamy Stock Photo:** Fabrizius Troy (cla). **Bonhams Auctioneers, London:** (fcra).**Dorling Kindersley:** Natural History Museum, London (clb, fbl, bl, br); Holts (tc, tr, fcla); Natural History Museum, London (crb); Natural History Museum, London (fbr). **iRocks.com/Rob Lavinsky Photos. 339 Alamy Stock Photo:** Arco Images GmbH (br); Steve Sant (fcla). **Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (cra, fcra, crb/Alexandrite, fcrb, fbl, fbr); Ruth Jenkinson / Holts (tl); Holts (clb). **Getty Images:** Corbis / ION / amanaimages (ftr). **iRocks.com/Rob Lavinsky Photos:** (fclb). **340 Alamy Stock Photo:** Goran Bogicevic (fbr). **Dorling Kindersley:** Natural History Museum, London (ftr, fcla, cra, crb); Ruth Jenkinson (fcra); Holts (clb). **Getty Images:** Arpad Benedek (cla); Ron Evans (ftl). **Roland Smithies / luped.com:** (tl). **341 Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (ftl, tl, tr, cla, fcra, crb, br); Tim Parmenter / Natural History Museum, London (ftr); Ruth Jenkinson (cra); Holts (fcla, fcrb, bc/Heliodor); Natural History Museum, London (br). **V&A Images / Victoria and Albert Museum, London. 342 Dorling Kindersley:** Natural History Museum, London (tr, br, fbr); Holts (tl, cla, cra, fcrb); Ruth Jenkinson (fcla). **343 Alamy Stock Photo:** Zoonar GmbH (fcra). **Dorling Kindersley:** Natural History Museum, London (fcla/Moldavite, cla/Kornerupine, fbl, bl/Microcline); Holts (tl, cra/Ammolite, fclb, clb, fbr). **344 Dorling Kindersley:** Natural History Museum, London (ftr, fcla, cra); Holts (tl, tr, fclb, cb, crb, br); Holts (fcra). **Getty Images:** Arpad Benedek (clb). **345 Dorling Kindersley:** Natural History Museum, London (ftr, cra, fcra); Holts (ftl, tr, fcla, fclb, fcrb, br, fbr). **346 Bonhams Auctioneers, London. Dorling Kindersley:** Natural History Museum, London (fcra, fcrb); Holts (ftl, tl, cra, fbr); Ruth Jenkinson (fclb, clb). **347 Bonhams Auctioneers, London:** (clb). **Dorling Kindersley:** Natural History Museum, London (tr, fclb); Holts (ftl); Ruth Jenkinson (cla). **Science Photo Library:** Natural History Museum, London (tl)

For further information see: **www.dkimages.com**